D4.3.1 Report on IOT Living Labs Continuous Exploration and Evaluation (initial version)

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SEVENTH FRAMEWORK PROGRAMME

Experiential Living Lab for the Internet Of Things

D4.3.1

Report on IOT Living Labs Continuous Exploration and Evaluation (initial)

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1 Executive Summary

This deliverable reports the present available data and results coming from the ELLIOT use-cases and scenarios. The report also provides some preliminary conclusions drawn from the performed analysis results. After the introduction, the document briefly sets out the purpose, intended audience and scope of the document. The rest of the document focuses on the use-cases and for each of them it will provide:

- ***Introduction*** – the scope and objectives of the use-case with some hints on the underlying motivations and expectations
- ***Collected data*** – this section will deal with sensor data collected during the workshops as well as observation data collected during the workshops.
- ***Analysis of collected data*** – this section will deal with the findings of the performed analysis of sensor data as well as observation data collected during the workshops.
- ***Preliminary conclusions and data inference coming from performed analysis*** – this section will deal with the collected evidence of acceptance and attractiveness of IOT-based solutions as well as perceived benefits, strengths, weaknesses, opportunities and threats.

The document presents then some conclusions and in particular points out that due to the very specific evolutionary nature of Living Labs will require updating in the future.

2 Introduction [UR]

The main goal of the ELLIOT (**E**xperiential **L**iving **L**abs for the **I**nternet **O**f **T**hings) STREP project is to develop IoT technologies and Ambient Intelligence (AmI) services by and for users/citizens, through the design of a set of KSB (Knowledge-Social-Business) Experience Models and their implementation in an innovative ELLIOT Experiential Platform operating as a knowledge and experience gathering environment. The early involvement of users/citizens, as recommended in the ICT Work-programme, will be conducted according to the precepts of the Open User-Centred Innovation paradigm and through the co-creation and experimentation of the Living Lab approach which aims to involve users/citizens in research and innovation pathways. This combination of market pull and technology push is expected to have a positive impact on the development and adoption of IoT technologies and innovative services.

2.1 Purpose, Intended Audience and Scope

The purpose of this document is to provide WP2 (development of the experiential platform) with the needed feedback from the project use-cases (bottom-up approach) so that these outcomes can be effectively integrated with the modelling effort coming from WP1 (top-down approach) within the ELLIOT experiential platform.

The intended audience of this deliverable is essentially the project development community but it also includes those IoT solution developers/providers who in the future may be willing to adopt the ELLIOT platform to assess their offerings and therefore need to understand both how to use it, and the constraints and operational conditions which were taken into account by previous Living Lab users.

2.2 Applicable Documents

Example of applicable documents

AD(1). EC Communication Guidelines for Projects
http://cordis.europa.eu/fp7/ict/participating/communication-best-practices_en.html

AD(2). ELLIOT DOW

AD(3). D6.1 Project Handbook and Quality Plan

AD(4). D1.1 KSB Experience Model Overall Framework

AD(5). D2.1.1 User Requirements and Architectural Design (first version)

AD(6). D4.1 Specification of the IoT Use Cases

AD(7). D4.2.1 Report on IoT Living Labs Methodology and Tools

3 Logistics Use-case [BIBA]

Data presented in this deliverable regarding the Logistics Use Case Living Lab, has been selected from Living Lab workshops dealing with the **Co-Creation** and **Exploration phase**. Both workshops have been attended in sequence by one group of participants. These, however, were the initial workshops of the Living Lab and the cycle has not been entirely concluded (first iteration, see Table 1).

Location	Date	Living Lab Phase	Duration (h:m:s)
Bremen (BIBA)	25.01.2012	Co-Creation	04:26:11
Bremen (BIBA)	27.01.2012	Exploration	01:12:13

Table 1: Details of analysed Living Lab Workshops of the Logistics Use Case

The Living Lab workshops were attended by students mainly from the University of Bremen Industrial Engineering programme (Table 2). Therefore their background knowledge can be considered as similar, even though the expertise of each participant is slightly different. All have an engineering background. Due to the restrictions given by the serious game, only five participants could take part at a time, .

General Information about LL participants			
Age	**Sex**	**Profession**	**Expertise**
25	m	Student	industrial engineer
22	m	Student	Production Engineering
22	w	Student	industrial engineer
22	m	Student	industrial engineer
24	w	Student	industrial engineer

Table 2: General Information about Living Lab participants of the Logistics Use Case

With an average age of 23 and a ratio of sexes 3:2 (3 male: 2 female) the sample of participants was the “best available”. Still, taking into account that the majority of engineering students are male, this might not provide a perfect sample. Nevertheless, having the best possible mix based on the available players or game, this sample is able to provide a non-gendered result.

Overall this cannot be seen as a representative sample neither for the population of Bremen nor for the student population of the University of Bremen. Even regarding the number of students in engineering at the University of Bremen the sample is too small to be representative.

This limitation will change by inviting bigger student groups into the living lab. The planned extension to an industrial partner would further broaden the perspectives included in the evaluation and the development of services. Nevertheless, in this case it has to be taken into account that this living lab focuses on a service development which is not relevant to the majority of the population but only for professionals. Thus the number of participants and their representative status has to be compared only to those people affected. This way the amount needed for a representative group decreases heavily.

The used indicators in this deliverable are those named in D4.2.1. The usability of these indicators has been evaluated during the living lab. Those indicators which require adjustments are discussed in further detail. Furthermore, the KPIs from the KSB model are used to analyse the collected data and the applicability of these KPIs for the logistics use case is discussed.

Since the developed IoT service from the living lab has not reached the **experimentation phase** to practically test the service on the shop floor, no sensor data for this phase has been collected so far.

During the Logistics Use Case evaluation phase the developed service will be evaluated regarding its performance compared with the expectations of former Living Lab phases (from Co-Creation to Experimentation). Thus less data will be collected by the sensor tool kit but it will be analysed and inferences will be drawn. Therefore the analysis presented here can be seen as part of the living lab evaluation.

3.1 Collected data

3.1.1 *Sensor data collected during the workshops*

During the living lab and tool kit development the list of risk detection sensors (see D4.2.1, chapter 7.2.2, IOT raw data) has been reviewed and adjusted. In addition it is expected that this list will further develop as new sensors are added.

The updated list of sensors is shown in Table 3.

Category	Data Source	Data ID	Data measure
IOT raw data	Risk detection sensors	R1	Temperature
		R2	Humidity
		R3	Light level
		R4	Heart rate
		R5	Pressure (Air)
		R6	Pressure (Mechanic)
		R7	Distance
		R8	Rotation angle X-axis
		R20	Rotation angle Y-axis
		R21	Rotation angle Z-axis
		R9	Yaw rate X-axis
		R22	Yaw rate Y-axis
		R23	Yaw rate Z-axis
		R10	Vibration
		R11	RFID
		R12	Fingerprint
		R13	Compass
		R14	Lifter use
		R15	GPS
		R16	Video stream
		R17	Microphone
		R18	Altitude
		R19	Ubisense (Indoor-Localisation)

Table 3: Updated Sensor List of Logistics Use Case Tool Kit, indicating collected data

One important reason for the adjustment of the sensor table developed from the fact that certain sensors such as the accelerometer are able to provide various pieces of information; for example the three rotation angles and the three yaws rates from the gyroscope sensor module. However not all of this information is needed for each service which might be developed. Each aspect (e.g. each axis) of sensor data is treated as one sensor in the data base. This is the case, even if the sensor data might be provided by one single sensor module. Furthermore two corrections had to be made. Sensor R8 is not measuring the *level* but the *rotation angle*. Accordingly the sensor R9 is not measuring the *rotation angle* but the *yaw rate*. Beyond that, *yaw rate* and *rotation angle* both cover three dimensions and were therefore split into three data sets each, one for each axis.

During the **Co-Creation phase** no sensor specific data is collected due to fact that the sensor tool kit in the logistics use case is not used in this phase nor has it been introduced to the living lab participants in this living lab phase. Nevertheless the utilisation of the tool kit for collecting data from the co-creation phase is discussed and certain toolkit sensors are tested for this purpose. Once sensors which provide reliable data for this purpose are selected and the participants get to know the tool kit, the sensors and the tool kit itself could also be used during the co-creation phase (see chapter 3.3.2).

Nevertheless serious games provide data which is related to sensor data. These are namely the name/kind and number of sensors used in a service as well as the number and kind of actuators used in a service. Within the selected Living Lab two sensors have been selected for use in a service (see table 4).

Category	Data Source	Data ID	Data measure
IOT raw data	Risk detection sensors	R7*	Distance
		R9*	Rotation angle X-axis

Table 4: Sensors used for the virtual service developed in the Serious Game (Co-Creation Phase)

Additionally, so called observation data in the Logistics Use Case could be derived directly from the serious game, namely data referring to the indicators BP1, BP7, BP11, BP12, BP13, BP14, BP15 and BP19 (see Table 7 and Table 9 in chapter 3.1.2).

In the **exploration phase** the Living Lab participants get introduced to the (Arduino) sensor tool kit. They have the opportunity to check functions, to connect sensors and to experience the sensor data output on screen in the form of a graphical and numerical presentation. During the Exploration Phase of the Living Lab those sensors listed in Table 5 were connected.

Category	Data Source	Data ID	Data measure
IOT raw data	Risk detection sensors	R4	Heart rate
		R7*	Distance
		R9*	Rotation angle X-axis
		R10	Rotation angle Y-axis
		R11	Rotation angle Z-axis
		R15	Vibration
		R16	RFID
		R18	Compass

Table 5: Connected Sensors during Living Lab workshop (Exploration Phase)

However, from this sensor selection only two sensors have been used in a service solution. Due to this, only data from this developed service has been logged;[1] these sensors are the distance sensor R7 and the accelerometer sensor module with the Rotation angle of the X-axis R9. The perspective on sensor data includes the raw data the sensors are measuring (distance, rotation, etc.) as well as log data from the tool kit about the sensors (such as the number of sensors, time stamps, etc.; data not directly related to the sensor specific purpose). Due to the amount of data, the sensor raw data output is not presented here. Instead raw data will be presented where it is relevant for the analysis. Additionally Table 6 shows the elaborated data from the tool kit during the exploration phase. For the exploration phase the tool kit and its User Interface (UI) were connected for 1 hour and 12 minutes. During this time the participants familiarised themselves with the toolkit and checked the above mentioned sensors. Furthermore the IoT setup of the developed service was discussed and adjusted by the participants. For the analysis in chapter 3.2.1 a specific period of 158 seconds (Q3) has been selected where the LL participants checked their IoT setup after a discussion about its adjustment. The values for Q4 in Table 6 report the five thresholds crossing during the examined time period. The GPS module (Q5) was not connected because it does not work properly indoors. In the future the UbiSense sensor (see Table 3 indicator: R19) will provide the sensor position on the BIBA shop floor area, which is used for the experimentation phase. It has further to be taken into account that indicator Q6 has not been elaborated from sensor data but in this particular case by observation. Therefore the indicator Q6 is dealt with in chapter 3.1.2.

Category	Data Source	Data ID	Collected Data	Value
Qualified Data	Elaborated data	Q1	# of logged user per day	1
		Q2	# of risk threshold crossings	5
		Q3	Time spent by user per session (from login to logout)	3 min (1:12 h)
		Q4	Time of threshold crossing	(2, 3, 92, 4, 9 s)
		Q5	Travel history (GPS)	GPS not connected
		Q6	Noise level during workshop (h,m,l)	(See chapter 3.1.2)

Table 6: Elaborated Data from the Sensor Tool Kit

[1] During the ongoing improvement of the tool kit, based in finding from the living lab, the Toolkit Log has already been adjusted to log more data during the exploration phase.

3.1.2 *Observation data collected during the workshops*

Table 6 shows the indicators for which corresponding data has been collected by observation in the Living Lab **co-creation** phase. In this table the indicator Q6 is added because the noise level in this particular case has been assessed by observation. In future Living Lab iterations the sensor tool kit attached with a microphone shall be used to derive this information directly.[2]

Category	Data Source	Data ID	Collected Data	Value
	Elaborated	Q6	Noise level during workshop (h,m,l)	**medium**
Qualified Data	Observation h = high m = medium l = low	BP3	# of interactions between participants during workshop	*Evaluation calculated in a spreadsheet*
		BP4	Acceptance of processes suggested by moderator (h,m,l)	**high/ medium**
		BP5	*# of disagreements during LL processes among participants*	*/*
		BP7	# of risk situations found in Co-Creation phase *(derived from scenario)*	**6**
		BP8	Attractiveness of the most recent IoT service (h,m,l)	**medium/ high**
		BP11	# of different considered objects for IoT	**5**
		BP12	# of created risk contexts *(risk logic)*	**1**
		BP13	# of personal identifiers for operators	**0**
		BP14	# of created IoT services	**1**
		BP15	ratio of actors and sensors	**1:2**
		BP19	# of sensors and actuators together	**3**

Table 7: Observation Data from the Co-Creation phase

Indicators in Table 7 which were not relevant to the co-creation phase were not collected. There are various reasons as to why certain indicators were not collected. For example some indicators are not relevant to this phase or iteration of the Living Lab or they are collected by the tool kit which is not used during the co-creation phase. Others are relevant but could not be collected from a logistical point of view.

[2] Due to technical problems with the provided microphone module this could not be realised at this stage. Therefore a qualitative observation was performed in order to collect convincing data for this indicator.

The first category includes the following indicators: BP2, BP9, BP10, BP16, BP17, BP18, BP20, BP21, BP22, BP23 and BP24 which are mainly evaluated during the exploration and experimentation phase.

An indicator which could not be evaluated logically is BP1, as the data required to evaluate it refers to the second Living Lab iteration which has not yet been performed. No second co-creation phase has been performed yet and thus no former risk situation exists. In future iterations of the Living Lab this indicator will be collected.

The ascertain-ability as well as the usability of the indicator **BP3 (**# of interactions between participants during workshop) was specifically investigated. Due to findings of the Living Lab the indicator was changed. Instead of counting the number of interactions, the kind of allocation of interactions in terms of heterogeneity or homogeneity was appraised. Further the verbal activity of participants was quantitatively evaluated, regardless of their qualitative impact. This approach was applied by dividing the co-creation phase into the process steps used in the corresponding serious game. For each step the process time, the participant's activity and from this the *heterogeneous or homogeneous allocation of inter-activity* was derived. This means that the active participation of each participant has been evaluated, and from this, for each process step, the characteristics of allocation have been derived. It is assumed that this classification is fitting as the serious game for the logistics use case actually covers the co-creation phase. The collected data for BP3 is discussed in chapter 3.2.2.

The indicator **BP5**, which is still listed in Table 7, has not been collected. It became obvious during the real time observation as well as during the study of the video observation that some indicators cannot be collected by means of human observation in a reasonable time. Additionally, the indicator BP4 might be changed. These aspects are further discussed in chapter 3.3.

Those indicators which are evaluated and classified in qualitative terms of "high, middle or low" can have an additional trend. This tendency is indicated by "/" and the abbreviation of the classification (h, m, l). For example, BP4 (Acceptance of processes suggested by moderator) was rated high with a tendency to medium (high/medium). This takes into account that the observation has been performed by more than one person in order to check the proposed categorisation. Those indicators, without additional trends were equally rated by all observing persons.

Q6, BP3 and BP8 are all qualitatively valuated. Their measurability will be discussed, based on the observation results. Furthermore for the indicator BP4 a different approach is suggested (see for this chapter 3.3).

After the workshops **questionnaires** were used to collect more impressions about the workshop and the service from the participants.

The participants and the observer(s) have been asked about their judgments regarding the usability of the service, the learnability, the usefulness and additionally about their subjective impression about the noise level during the workshop[3]. Further questions about the "Acceptance of processes suggested by moderator" and the "Attractiveness of the most recent IoT service" have been asked of the participants. For all these questions the qualitative range of "high", "middle" and "low" was given.

Category	Data Source	Data ID	Collected Data	*counts*	Value
Qualified Data	Questionnaire h = high m = medium l = low	C1	Usability of the service (h,m,l)	*Q*	high
		C2	Learnability (h,m,l)	*Q*	medium/high
		C3	Usefulness (h,m,l)	*Q*	high/medium

Table 8: Data from Questionnaire regarding the Co-Creation Phase

The co-creation phase, as well as the following exploration phase, was concluded by a feedback and discussion round. Besides the collected data, findings from this discussion are used to improve the living lab and used tools (the serious game and the tool kit). The feedback and discussion are not documented in terms of collected data, but in this case were captured by video.

Exploration Phase

Table 9 shows the indicators for which corresponding data has been collected by observation of the Living Lab **exploration** phase. As above in Table 7, the indicator Q6 is added because the noise level in this particular case has been appraised by observation.

The comment in brackets for BP11 in Table 9 indicates that the forklift is the only object considered for IoT. The brackets in BP13 and BP15 refer to a suggested service with a heartbeat sensor the Living Lab participants considered, without finally creating the service

[3] Given the chosen experimental settings, noise could be used as an indicator of interaction among participants

with the tool kit. Lastly , the brackets for the value of BP21 indicate that the data of the tool kit so far is open and a decision as to whether or not the data should be secured was not made by the participants.

Category	Data Source	Data ID	Collected Data	Value
Qualified Data	Elaborated	Q6	Noise level during workshop (h,m,l)	low/m
	Observation h = high m = medium l = low	BP1	Avg. # of former risk situation users can remember	**6**
		BP2	# of times physical sensors are used to explain IoT setup during workshop	**6**
		BP3	# of interactions between participants during workshop	**heterogeneous**
		BP4	Acceptance of processes suggested by moderator (h,m,l)	**high/m**
		BP8	Attractiveness of the most recent IoT service (h,m,l)	**medium/low**
		BP9	Understand ability of risk detection outputs (h,m,l)	**medium**
		BP11	# of different considered objects for IoT	**1** (forklift)
		BP12	# of created risk contexts	**2**
		BP13	# of personal identifiers for operators	**(1)** (heartbeat)
		BP14	# of created IoT services	**1**
		BP15	ratio of actors and sensors	**1:2** (1:1)
		BP16	# of communicating micro controllers	**2**
		BP19	# of sensors and actuators together	**3**
		BP20	time the service is in use	**1:12 hour/s**
		BP21	Is data secured or open?	**(open)**
		BP22	Is there a role-based permission system enabled?	**No**
		BP23	Is it possible to delete data?	**no**

Table 9: Observation Data from the Exploration phase

Indicators not mentioned in Table 9 are not relevant to the Exploration phase and were therefore not collected. Reasons for irrelevant indicators are similar to those stated for the co-creation phase. In this phase (Exploration) the tool kit is used but some indicators are still not relevant for this phase or iteration of the Living Lab. This includes the following indicators: BP5, BP7, BP10, BP17, BP18 and BP24. These last named indicators are mainly evaluated during co-creation and experimentation phase.

The Living Lab participants were given a **questionnaire** covering the same questions as after the co-creation phase. The average value of the answers (high, middle, low) is shown in Table 10 (trends as explained above).

Category	Data Source	Data ID	Collected Data	Value
Qualified Data	Questionnaire h = high m = medium l = low	C1	Usability of the service (h,m,l)	**medium**
		C2	Learnability (h,m,l)	**medium/high**
		C3	Usefulness (h,m,l)	**high/medium**

Table 10: Data from Questionnaire regarding the Exploration Phase

3.2 Analysis of collected data

The data collected from the workshops, which is presented in the above chapter 3.1, is analysed in the following chapters in terms of the KSB model.

3.2.1 *Analysis of sensor data collected during the workshops*

The KPIs from the **KSB** model shown in Table 11 are related to sensor data. Four of these KPIs rely on sensor data while the other KPIs also rely on observation data which is not (directly) collected by sensors.

	Ref	Properties	*Input*	*Involved Indicators*
Knowledge	**K4.1**	Human computer interaction	Observation	Q4, BP18
	K7.2	Shared meanings	Observation, Elaborated	BP2, BP24, BP11, BP7, BP14, Q4

	Ref	Properties	*Input*	*Involved Indicators*
Social	N.A.			
Business	**B1.2**	Performance level (IoT)	Log evaluation	Q2, Q4
	B5.2	Accessibility	Log data	R14
	B6.3	User data (profile & digital identity)	Elaborated	Q1-5
	B7.2	Anonymity	Observation, Sensor	R12

Table 11: KSB KPIs with sensor related indicators involved

For KPI **K4.1 - Human computer interaction** the indicator Q4 was collected and five threshold crossings were found with the following durations: 2, 3, 92, 4 and 9 seconds. BP18 is not collected during co-creation of exploration phase and therefore no value is given for this indicator. During the first two tests crossing the threshold occurred only for a few seconds while the third crossing lasted 92 seconds. The last crossings again were below ten seconds, even though a little longer than the first ones. A vague analysis of the numbers and durations of the threshold crossings could lead to the result that during the exploration some adjustments of the risk thresholds are necessary to ensure the expected result.

In the Knowledge category the KPI **K7.2 - Shared meanings** are mainly based on observation and elaborated data from the sensor tool kit (Q4). This indicator will therefore be treated in chapter 3.2.2. Further, no social KPI has been based on or derived from direct or indirectly sensor data.

The Business **KPIs B1.2 - Performance level (IoT)** and **B6.3 - User data (profile & digital identity)** are based on elaborated data. B1.2 describes the Performance Level of IoT and is derived from Q2 (# of risk threshold crossings) and Q4 (Time of threshold crossing). In this case the fact that the data refers not to the experimentation phase but to the exploration phase has to be taken into account. The conclusion that risk levels were reached approximately every 32 seconds can be drawn from the data which is a very high rate for a normal working environment. Whilst exploring the service outside the real environment these values do not seem to have much significance in terms of Business. The same conclusion can be drawn for the KPI B6.3 as in the exploration phase not a single user was using the service nor was the service implemented in a real environment. Therefore a proper user profile other than "user: all Living Lab participants" cannot be identified. This KPI should be derived from the experimentation phase where the service is tested by different users separately.

KPI B5.2 describes the **accessibility** of the service. In terms of the logistics use case this describes the use of the service equipped forklift, i.e. how often, how long and by how many different personnel the forklift is used. This data can only be collected during the experimentation phase. In addition to the given sensor it might be useful to determine whether this indicator might be derived from more than one data source. Furthermore how and on which data base the accessibility can properly be measured needs to be defined.

A statement about the **anonymity** of the service is made in **KPI B7.2**. As the developed service does not so far use any kind of sensor which identifies personnel individually, anonymity is guaranteed.

3.2.2 *Analysis of observation data collected during the workshops*

KSB KPIs shown in Table 12 are (mainly) related to observation data. The relevant, underlying data from the indicators has been collected in the Living Lab workshops.

For those KPIs marked with ***** in Table 12, all of the formerly in D4.2.1 named indicators are available in terms of data. Such these indicators can be analysed, whereas the validity of the remaining KPIs is already limited. Therefore only those KPIs for which enough suitable data is available will be analysed.

	Ref	Properties	*Input*	*Involved Indicators*
Knowledge	K3.1*	Internal representation	Observation	**BP2** (exploration)
	K4.3	Cognitive artefacts	Observation	**BP15**, BP17, **BP19**
	K6.2	Cognitive coordination	Observation	**BP3**, BP5
	K7.2	Shared meanings	Observation, Elaborated	**BP2**, BP24, **BP11**, *BP7*, **BP14**, Q4
Social	S2.1	Communication	Observation	**BP3**, BP5
	S3.2*	Influential behaviour	Observation	**BP4**
	S7.1*	Attractiveness	Observation	**BP2**, **BP3**, **BP7**

	Ref	Properties	*Input*	*Involved Indicators*
Business	B1.1*	New functionalities (IoT)	Observation	**BP14**
	B1.3*	Automation capacity (IoT)	Observation	**BP15**
	B1.4*	Connectivity (IoT)	Observation	**BP16**
	B2.4*	Maintainability (IoT)	Observation	**BP11**, **BP12**, **BP19**
	B3.2*	Ease of use	Observation, Questionnaire	**BP20**, **C1**
	B3.3*	Learnability	Observation, Questionnaire	**BP9**, **C2**
	B3.5*	Flexibility	Observation	**BP14**, **BP16**, **BP12**
	B4.1*	Usefulness	Questionnaire	**C3**
	B4.4	Affordability	Observation	**BP20**, **BP19**, BP18, **BP7**, BP1
	B5.3*	Availability	Observation	**BP20**
	B6.1*	User ideas	Observation	**BP14**, **BP11**
	B6.2*	User created content	Observation	**BP7**, **BP12**
	B7.1*	Data protection	Observation	**BP21**
	B7.3*	Selective use permission	Observation	**BP22**
	B7.4*	Own Data destruction	Observation	**BP23**
	B8.1*	Confidentiality constraints	Observation	**BP21**

Table 12: KSB KPIs with observation related indicators involved

For KPI **K3.1 - Internal representation** the indicator BP2 is used which refers to "the number of times physical sensors are used to explain IoT setup during the workshop". This indicator is initially collected in the exploration phase. In this case they were used six times. As no data exists with which to compare this value, a valid statement for K3.1 cannot be derived.

The indicator BP4 which states the "Acceptance of processes suggested by moderator" with relevance for the Social **KPI S3.2 (Influential behaviour)** was rated during the co-creation and the exploration workshops as being exactly the same: "high" with a tendency to medium. Thus the influential behaviour of the moderator was high. Depending on the interpretation and the context of the workshop this might either be a good or bad performance.

The relevant indicators for the **Social KPI S7.1 – Attractiveness** of the service and the Living Lab are BP2, BP3 and BP7. For **BP3** it can be said that the allocation of interactions changed from an equal allocation between heterogeneous and homogeneous phases in the Co-Creation phase to a strongly heterogeneous communication situation in the exploration phase (as explained in chapter 3.1.2 for BP3). During the co-creation phase three out of five participants played a stronger role whereas during the exploration phase only one participant dominated. This might explain why the interactions changed from equal allocation between heterogeneous and homogeneous to a strongly heterogeneous allocation. The indicator **BP2** is only relevant in the exploration phase where (during the workshops) the physical sensors were used six times to explain the IoT setup. As mentioned earlier, no comparable figure exists so far. In contrast to BP2, **BP7** only has relevance to the co-creation phase; therein six different risk scenarios have been found by the participants and again there is no comparable figure. Overall, strong evidence about the attractiveness of the service cannot be derived from the available data. Nevertheless, taking into account that the sensors were used more than once to explain the IoT setup, this might indicate an active explanation. If these explanations were mainly given by one participant the heterogeneous allocation could be explained. Such a situation was observed during the Living Lab session and was confirmed by the analysis of the video capture of the workshop. To some extent this might indicate an average attractiveness of the service and the Living Lab. This conclusion is consolidated by the analysis of the video capture. A differentiation between the two aspects of the Service vs. the Living Lab would be very difficult. Therefore this KPI might need some review.

The majority of KPIs are those related to Business in the KSB model. The first business **KPI**, **B1.1** – **new functionalities (IoT)** is based on the indicator BP14 - number of created IoT services. During the Co-Creation and the Exploration phases one service has been developed. Taking into account that this was the first Living Lab iteration this result is not surprising. Additionally, it is expected that additional services will be developed while the number of Living Lab iterations grow. Still, this KPI needs further investigation in order to make sure about this expectation.

The Business **KPI B1.3** – **Automation capacity (IOT)** refers to the ratio of actors and sensors (BP15). This range has been 1:2 during Co-Creation as well as during Exploration. Additionally a service idea which was never realised was discussed during Exploration. This idea had a ratio of 1:1. Assuming that an equal ratio indicates a good automation capacity, the observed Living Lab performed very well. Still, the numbers (of actuators and sensors) this result is based on might be a limitation for the validity of the KPI; as one single actuator as well as one single (or two) sensors are very low numbers.

The **KPI B1.4 – Connectivity** (IoT) is derived from the indicator BP16 (number of communicating micro controllers). With a total number of two microcontrollers the developed service in this living lab did not perform well, taking into account that only a few sensors can be connected to one microcontroller and that a larger number of microcontrollers were available during the workshop.

The **KPI B2.4 – Maintainability** (IOT) is assumed to indicate a good performance once the total number of physical modules (sensors, actuators, microcontrollers, etc.) is low. A low number of modules mean less error potential and less locating activity to discover these modules. Thus this KPI is contrary to those KPIs supporting a high number of modules (e.g. B1.1, B1.3 and B1.4). For that reason, with BP11, BP12 and BP19, the relevant indicators are those referring to the numbers of sensors and actuators. In this case the total number of sensors and actuators altogether is three; therefore the maintainability is good.

The **Ease of Use** (Business **KPI B3.2**) was derived from the time the service has been in use (BP20) during the evaluated workshop and a questionnaire for the participants. The service was in use for 1:12 hours which covers a considerable period of the workshop. During the co-creation the participants rated the usability of the service as “high” whilst they changed this into “medium” during the Exploration phase. This might indicate a decreasing performance regarding KPI B3.2. This KPI needs further investigation over the whole Living Lab and further iterations (investigation over time).

As with B3.2, the Business **KPI B3.3 Learnability** is based on one observation indicator (BP9 – Understanding the ability of risk detection outputs) and one question from a questionnaire given to the Living Lab participants after the according workshop (C2 – Learnability). From the observation of the exploration phase BP9 was rated medium which correlates with the results from the questionnaire although the participants stated in the final discussion round of the workshop, that this aspect could not be evaluated very well. This is explained by being the first iteration which thus implies the need for some time to get used to the tool kit. Thus the learnability, at this stage of the process, seems to be on an average level but might need further improvement. This improvement will probably emerge more clearly from future iterations and especially during the experimentation phase.

Assuming that the **flexibility** of the service (**KPI B3.5**) correlates positively with the number of created risk contexts (BP12), the number of created IoT services (BP14) and the number of communicating micro controllers (BP16), the KPI performance of B3.5 is relatively low. This is due to the fact that only one risk context was created (in terms of further development into a service), further only one IoT service derived and the number of two communicating microcontrollers is low.

The **Usefulness** (Business **KPI B4.1**) was evaluated by the questionnaire (C3). With a rating of high (slight tendency to medium) the performance of this KPI is very good. Nevertheless, compared with other KPIs this result seems to need further investigation, as they indicate that the developed service lacks certain positive characteristics such as a higher number of sensors/actuators. On the other hand this might indicate that even services which appear "simple" might provide a high level of usefulness to the customer.

The **availability**, described by **KPI B5.3,** based on the time the service is in use (BP20), was 1 hour and 12 minutes during the Living Lab workshop in question. This is almost the whole session which indicates a high availability and thus a good performance of the KPI. Nevertheless, it has to be taken into account that this covers only the exploration phase and therefore does not say anything about the availability in a real environment. This needs further evaluation, especially during the experimentation phase.

With a decreasing number of different considered objects for IoT (5 to 1 from co-creation to exploration) and a total number of one (1) created IoT service the performance of **KPI B6.1 – User ideas** appears to be low.

The **KPI B6.2 – User created content** is based on the number of risk situations found in the co-creation phase (derived from scenario; BP7) and the number of created risk contexts (resulting in a risk logic; BP12). There were 6 risk situations found and 1 risk context developed during co-creation. In the exploration phase another risk context was suggested during the experimentation phase (but finally did not result in a service). These results from the indicators BP7 and BP12 assume a low performance of this KPI.

The **KPIs B7.1 - Data protection**, **B7.3 – Selective use permission** and **B7.4 – Own Data destruction** are based on binary values; either open or secured data (BP21/B7.1), or Yes or No (BP22/B7.3 and BP23/B7.4). Whether open or secured data indicates a better performance

(B7.1) is not defined. However it is assumed that a role-based permission system (BP22 for B7.3) and the possibility to delete data (BP23 for B7.4) indicate positive performances of related KPIs. Thus the latter KPIs are low performing with BP22 and BP23 valuing "no".

The above mentioned indicator BP21 ("is data secured or open") is also used to express Business **KPI B8.1 – Confidentially constraints**. As data is not secured (but open) confidentially constraints could be assumed and thus the performance of B8.1 is low. This KPI and corresponding indicator should be investigated in comparison to KPI B7.1 to clarify whether the KPIs are both equally correlating or not.

3.3 Preliminary conclusions and data inference coming from performed analysis

From the logged sensor data and the observed workshops a database according to the indicator list from D4.2.1 has been created. During the on-going investigation and development of the logistics for the Living Lab and its related tools, these indicators have been adjusted. Furthermore the KPIs from the KSB model have been derived and first challenges arising from them were indicated. In section 3.3.1 the so far derived results will be examined with a focus on the acceptance and attractiveness of the developed IoT service from the logistics of the Living Lab. In section 3.3.2 the focus is more on challenges and opportunities regarding the service, but includes the overall Living Lab and its tools.

3.3.1 *Acceptance and attractiveness of IOT-based solutions*

Regarding the acceptance and attractiveness of the service solution which was developed during the workshop the majority of the Business KPIs indicate a low performance of the service. In addition Knowledge and Social KPIs do not provide significant results in order to draw a conclusion. Nevertheless it has to be taken into account that the evaluated Living Lab was an initial iteration where the participants were presented to the task for the very first time. This includes all the tools used such as the game and in particular the toolkit.

Despite these preliminary findings about the first developed service, results which could be derived from some indicators or KPI as well as from discussions and feedbacks after the workshops indicate potential for a significant improvement of the service during further iterations of the Living Lab.

When looking closer on some indicators, this expected potential might become clearer.

Regardless of the needed review of KPI S 7.1 - Attractiveness, the findings from the co-creation phase indicate an almost equal involvement of the participants in the co-creation phase. Also the heterogeneous involvement during the exploration phase does not per se indicate a lack of attractiveness. Moreover, examining the questionnaire results, the participants rate the usability, the learnability and the Usefulness at least medium (or high). Further the acceptance of processes suggested by the moderator and the attractiveness of the most recent IoT service were rated *high* by observation and as well by participants. Participants were asked during workshop discussion about attractiveness, usefulness and probable acceptance of the service as well. These qualitative discussions and feedbacks given by the participants support the assumption that the service could also be improved by performing more iterations of the service and improving the knowledge about the tool kit. It is further expected that by improving the knowledge about the living lab process, the improvement process of the service might be supported.

3.3.2 *Perceived benefits, strengths, weaknesses, opportunities and threats*

New findings were derived from the living labs and the collected data regarding the service. The participants stated that they gained a positive experience and insights on IoT and related technologies.

Based on the data analysis and the findings from the workshops, the serious game and the toolkit were already changed and expected to improve the future iterations. During the co-creation and exploration phase new ideas for sensor combinations were found which were not expected beforehand. These findings and the feedback from participants and experts provided new ideas to further improve the service.

Nevertheless, the participants additionally pointed out, that motivation for participating in the Living Lab has to be mainly intrinsic. Without any extrinsic incentive, from their point of view, the concept lacks the potential to be successful, if none or only low intrinsic motivation exists. This will further be observed during the following workshops. Besides, to ensure the comparability of the KPIs from each Living Lab, equal definitions should to be in place.

As an example[4] the KPI K4.3 - Cognitive artefacts might be used. One definition found for a “cognitive artefact” stated that a cognitive artefact is “a man-made, or man modified tool to

[4] There exist other examples like e.g. the KPI S3.2 - influential behaviour.

support mental activity. Examples include number systems, slide rules, navigational charts and even language itself." (http://people.brunel.ac.uk/~cssrmjp/homefiles/DCog_definitions.html) This KPI has not been investigated for the logistics use case. However the suggested indicators BP15, BP17 and BP19 might not even be the right selection to derive this KPI. When adjusting this – as well as other indicators – KPI, the adjustment needs a broad agreement in order to result in comparable values.

When evaluating the indicators in terms of their possibility to be collected and their potential contribution to derive KPIs, the indicator BP1, BP4 and BP5 came into the field of vision. BP1 provides the *Avg. # of former risk situation users can remember*. On the one hand this indicator needs a couple of iterations to be properly evaluated in terms of usability. On the other hand, this indicator has not corresponding KPI so far. This might support the suggestions about a discussion on the KPIs proposed earlier. The indicator BP4 - *Acceptance of processes suggested by moderator (h,m,l)*, actually used for the questionable KPI S7.1, was evaluated. As the context about those situations when the moderator interferes with process suggestions is not recorded, it might be helpful to know how many times the moderator had to interfere to support the Living Lab process in order to proceed. This might lead to a new indicator or an adjustment/substitution of the existing one.

Finally, the indicator BP5 - # of disagreements during LL processes among participants was found to be hard to be identified and wasn't collected for that reason. Due to the configuration of the logistics use case, the sensor tool kit does not exist at the initiation of the Living Lab. Nor can it be expected that a full developed solution exists after the first lab cycle. On the other hand the service needs evaluation by the ELLIOT platform, therefore data is needed. One approach could be to diminish the number of KPIs needed and therefore of needed indicators. Thus the amount of observation data could be reduced. Additionally the potential of the tool kit could be used before a service has been fully developed in the Living Lab.

Based on the experience with the workshops and the toolkit, as well as with some of the indicators, the potential of using parts of the toolkit to observe the Living Lab process was discussed. However this is not a core function of the IoT service in the logistics use case. Using the toolkit to observe the Living Lab participants adds another purpose and broadens the utilisation of the sensor toolkit. Therefore the potential of the toolkit to support the observations is examined and two promising approaches were selected to be further developed and implemented into the Living Lab.

One approach is to ″pre-attach" physical artefacts (in the first step cardboard boxes) with sensors invisible to the Living Lab participants. This idea arose from the observations that the participants heavily used a small metal model of a forklift and related pallets to describe risk situations. This model did not have sensors attached. Based on the observations it is assumed that objects which are expected to be involved in risk situations, in the living lab, are used for demonstration purposes. If these objects have sensors "invisibly attached", they will not influence the participants' ideation while at the same time information about the progress of the Lab could be provided. This would decrease the necessity of other observation methods.

A second approach is to use a microphone with the Arduino tool kit to observe the dB-level during the workshop. This might not provide very detailed information about the individual participants in the Lab but would furnish the general noise level (indicator Q6). Furthermore the development of the noise level could be examined afterwards, assuming that the dB-level is logged. This would also suit the purpose of decreasing the necessity of other observation methods. The fact that the plain dB-level does not give real insights on the kind of interaction has to be taken into account. Nevertheless, the co-creation and exploration workshops are performed in a very quiet environment and a changing noise level could therefore indicate important moments during the workshop. This information could be used to observe the corresponding video capture during noise level changes. Though this does not reduce other observation methods immediately it gives the opportunity for a better understanding of the Living Lab which might then lead to proper improvements of the observation.

Both mentioned approaches to further develop the observation of the Living Lab use the Arduino toolkit itself. This way no separate IoT system for observation needs to be applied in order to observe the IoT service. Still, it might be questionable to use the toolkit in this way as it is not its core purpose. However as long as no service exists or the service developed cannot observe the Living Lab, specifically not the co-creation or the exploration phase, this is assumed to be a practicable solution.

The improvement of the logistics use case is an on-going process. By adding sensors, changing the toolkit UI or changing processes of the lab or the serious game, user ideas are used, every time a workshop is performed, to improve the logistics for the Living Lab. The analysis of the collected data, presented here supports this idea. Based on the presented findings, indicators and KPIs are reviewed and adjusted. Overall, communication and agreements on KPI definition and usage seem to be helpful in order to further improve the validity of resulting KPIs.

4 Wellbeing Services [HSR]

Each Scenario created and developed by HSR corresponds to a specific phase of the Living Lab process. As illustrated by the image below, HSR has arrived at the experimentation phase for the Media Scenario and the exploration phase for the Personalised Service Scenario. With regards to the Tourism Scenario, the research centre has terminated the evaluation phase and is about to commence a new cycle of co-creation, whilst for the Public Transport Scenario the co-creation and exploration phase have finished and the implementation of the service in preparation for the experimentation phase has begun.

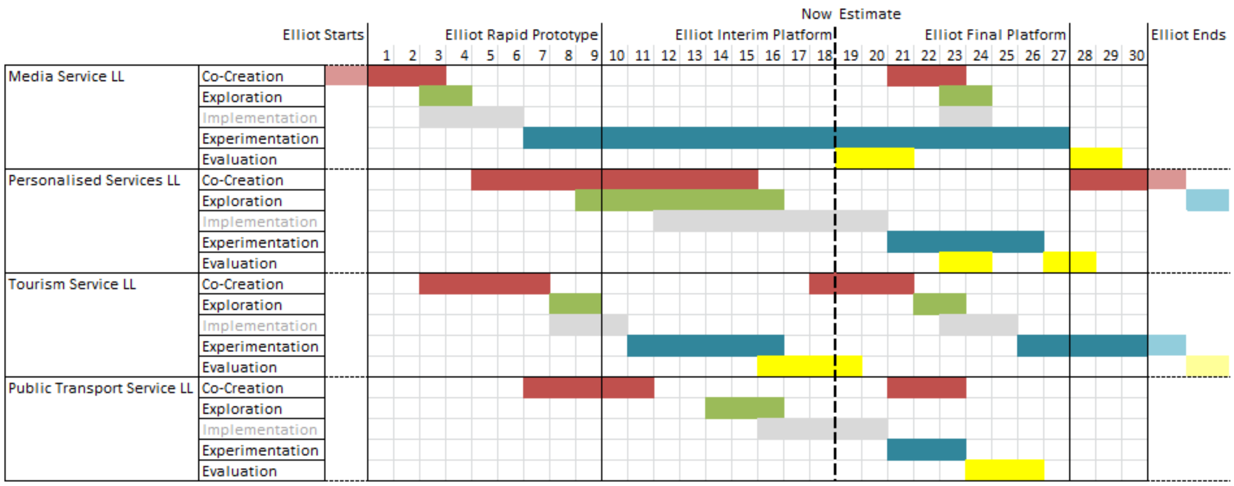


Table 13: Timeline of Services LL processes for HSR

4.1 Media Scenario

The co-creation phase of the first cycle of the Living Lab process for the Media Scenario was coming to its conclusion as the ELLIOT project was starting and therefore followed a separate methodology. The exploration phase lasted three months and took place in the first semester of the ELLIOT project. It consisted in the investigation of the outcomes gained from the co-creation phase, and their subsequent development into prototypes or mock-ups so that they could be validated by a selected group of technical staff, experts and/or a small number of end-users.

Technical staff and other experts tested both hardware and software solutions (in particular Edubuntu and Magic Desktop as operating system/layer) for the scenario as well as different touch screen TV solutions (see Figure 1 and Figure 2). A number of children were also asked to test the touch screen monitor and to give their opinion regarding the applications contained in Edubuntu and Magic Desktop. Strengths, weakness and preferences (likes/dislikes) were collected and were used to refine and select which of the software applications to test in the experimental Living Lab inside the Paediatric Department.

Figure 1: Hardware selection for the TV in Paediatric Department during exploration phase

Figure 2: Software selection for both Magic Desktop and Edubuntu during the exploration phase (to be tested in the experimentation phase)

4.1.1 *Experimentation*

The Media Scenario finds itself presently in its experimentation phase, which is the first phase of the Future use case that HSR wants to truly integrate with the experience analysis platform of the ELLIOT project. The expectations are that it will act as a forerunner that will enable the integration of all the remaining scenarios with the platform. For this reason a specific data collection architecture was designed so that it could merge itself with the architecture of each project. Two important elements compose this data collection architecture:

- A daemon software was developed for the interactive TV, able to semantically elaborate in real time images collected via the interactive TV webcam so as to not require the storage of video streaming and therefore respect users' privacy. With the implementation of the open source library OpenCV, an algorithm was also developed for face counting. This library offers numerous functions and already integrates itself with advanced techniques of computer vision. Other algorithms for semantic analysis are being studied, which could help to better understand the user experience. This daemon is also able to track logged users, what application is running and being used, as well as execution times.
- At the same time, a server containing a MySQL database was set up in the eServices for Life and Health labs, where all raw data collected by the IoT system embedded in the interactive TV installed in the paediatric department converges. A Hydra middleware client application is being installed, the same used by the ELLIOT platform, to enable both Push and Pull operations in order to have the raw data flow within the entire system.

As stated in deliverables D2.1.1 e D4.2.1, HSR is proceeding with the experimentation phase and data collection.

The chart below illustrates the data and source collected during the experimentation phase of the Media Scenario.

Category	Data Source	Data ID	Collected Data
IOT row data	Interactive TV	R1	Logged user (age group)
		R2	Process ID
		R3	Name of application in use
		R4	Time
		R5	Date
	Webcam	R6	Stream video (not sent to Elliot)
		R7	# of children in front of the monitor every 10 seconds
	Microphone	R8	Stream audio (not sent to Elliot)

Table 14: Raw collected in the experimentation of Media Scenario

In order to have enough indicators able to offer ways of mapping the KSB model, second level indicators were also introduced to understand the elaboration capabilities and requirements of the platform.

Category	Data Source	Data ID	Collected Data
Qualified Data	Elaborated	Q1	# of logged user per day
		Q2	# of application used by user
		Q3	Time spent by user per session (from login to logout)
		Q4	# of children in front of the monitor per application
		Q5	# of children in front of the monitor per logged user
		Q6	Time spent for educational applications
		Q7	Time spent for entertainment applications
		Q8	# of children in front of the monitor per educational application
		Q9	# of children in front of the monitor per entertainment application
		Q10	variance of children in front of the monitor per application
	Behavioural Paths	BP1	# of people who play only with entertainment applications
		BP2	# of people having sessions including entertainment apps before educational apps

Table 15: Qualified Data or second level indicators

Last but not least, KPI means of the KSB model was also identified so as to evaluate the user experience related to the Media Scenario, with their corresponding primary and secondary level indicators, useful in quantifying the value of the same KPIs.

	KPI	KPI Means	*Involved Indicators*
Knowledge	K4.1	Human computer interaction	Q1,Q2,Q3
	K6.1	Team cognitive process	Q8
	K6.2	Cognitive coordination	Q8
	K6.3	Shared cognition and off-loading	Q8
	K7.3	Mutual understanding	Q8
	K7.4	Group consciousness	Q8
Social	S1.1	Social Networking	R7
	S2.1	Communication	R7
	S2.2	Collaboration	R7
	S4.2	Mutual goodwill	R7, Q6
	S4.3	Rewarding	Q3

	KPI	KPI Means	*Involved Indicators*
	S5.1	Sense of community	R7
	S5.2	Accountability	R7
	S5.3	Confidence	R7
	S7.1	Attractiveness	Q1, Q2, Q3
	S7.2	Appealingness	Q1, Q2, Q3
	S9.1	Socialisation	R7
Business	B1.1	New functionalities (IoT)	R3
	B1.2	Performance level (IoT)	Q2
	B1.3	Automation capacity (IoT)	Q3
	B1.5	Ambient Intelligence (IoT)	R1,R2,R3,R4,R5,R6,R7,R8
	B4.1	Usefulness	Q3
	B4.2	Emotional connection	Q3
	B4.3	Hedonic quality	Q3
	B4.4	Affordability	Q1, Q3
	B4.5	Productivity	Q3, Q8
	B5.1	Disseminability	Q1
	B5.2	Accessibility	Q1, Q3
	B5.3	Availability	Q3
	B7.1	Data protection	Indirect
	B7.2	Anonymity	Indirect

Table 16: KPI involved in the Media Scenario

4.2 Personalised Services Scenario

HSR has completed the co-creation and the exploration phase of the Personalised Services Scenario, and is about to start the experimentation phase by deploying a first version of an interactive smart vending machine in a temporary store Living Lab.

4.2.1 *Co-creation – persona and customer journey outlining*

Once hardware opportunities were explored and validated through partnering with our suppliers, the co-creation phase began with the direct observation of users by HSR's research team around the area where the smart vending machines will be deployed in the experimentation phase. The reason for this was to derive persona or profiles of typical users around which to build the services to be offered by the vending machines, so as to design services that truly respond to user needs, which fit with everyday behaviours and meet user objectives. Ten thousand people walk across the grounds of the HSR and from the observation of these, six profiles were drawn. Each persona was analysed in terms of their age and gender, their reason as to why they could be at HSR, why they might be hungry and what time of the day they could use a vending machine, their attitudes towards technologies and what sort of devices they might possess. Insights from the end users were extrapolated from the research team's observation of user's behaviours in relation to Vending Machines and will be investigated deeply in the experimentation phase.

Figure 3: The personas identified following a user observation phase

The personas identified and analysed range from a 10 year old child to a 65 year old man, and from a very hi-tech attitude of a person who possesses a Smart Phone and tablet to a very low-tech attitude of a person who only owns a past generation mobile phone and who uses a computer only sporadically.

These five personas were further analysed in relation to the interactions they could have with the Smart Vending after its installation, and therefore a customer journey for each persona was developed. The interactions with a Smart Vending Machine were derived by the direct observation of users with other vending machines and can be grouped into five macro categories: Approach to the Vending Machine (when a user comes across a Vending Machine and recognises it), Comprehension (when the user understands what the Vending sells and what it has to offer), Choice (when the user identifies the desired products to purchase), Payment (when the users buys the products, either cash or via direct debit), and Retrieval (when the machine distributes the product and the user extracts it from the Vending Machine).

Figure 4: Overview of the Customer Journey with a Vending machine

Since the City of the Future Living Lab team's objective is to offer additional interactive IoT-enabled services via a Smart Vending, the customer journeys of each persona was not only broken down into the previously described macro phases of a traditional customer journey to a vending machine, but separated further into two macro phases: front end (what the user does in front of the vending machine and what he/she wants to achieve from these actions) and back end (what the Smart Vending machine could do to respond to the user's actions to satisfy his/her needs, but also how the Smart Vending machine could offer more to the user via the whole IoT system).

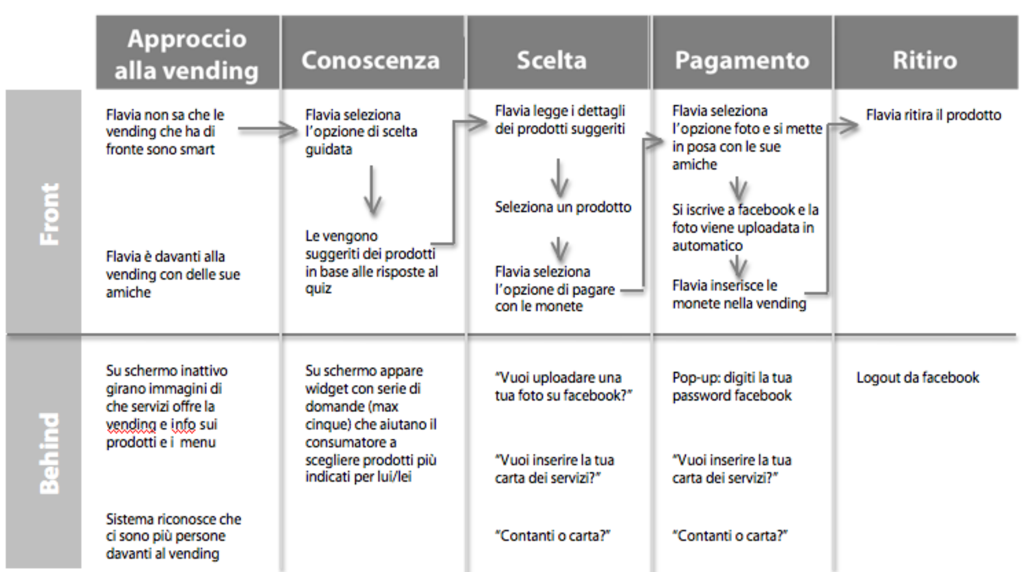


Figure 5: An example of a Customer Journey

4.2.1.1 Identification of potential services and user needs

In analysing users' behaviours with vending machines and via the development of persona profiles and their corresponding customer journeys in relation to a Smart Vending, some subtle issues were identified that could affect user interactions with HSR's Smart Vending Machines. These were identified through the collaboration of the City of the Future research team's acquired experience in the realm of ICT and IoT, with psychologists, nutritionists, external experts and SME collaboration:

- potential difficulty in identifying and decoding the Smart Vending Machine since traditional vending machines do not possess a touch screen;
- potential difficulty in the choice of a product since users cannot see the end product and must navigate the Smart Vending Machine's user interface to select a product (as on an e-commerce website, for example);
- potential difficulty in communicating the services offered by the Smart Vending Machine, correlated to the Service Card all Lombardy citizens possess, and making them appealing.

These potential pain points will be explored in detail throughout the upcoming experimentation phase of the Smart Vending Machine's Living Lab process.

At the same time, a number of opportunities were also identified and used to bring to life the Customer journeys and the Personalised Services solutions:

- provide easy to comprehend notions on healthy and sustainable eating and living in order to promote virtuous eating behaviour in users;
- provide users the opportunity of socialisation and easy access to social networks;
- give users the opportunity of accessing information regarding their health in an easy and intuitive manner in order to make conscientious food and lifestyle choices;
- provide users with entertaining contents while they wait for their selected product;
- involve children, senior citizens and low-tech individuals by overcoming the technology gap.

4.2.2 *Mock-ups throughout the Exploration phase*

The exploration phase for the Personalised Services solution consisted in the development of prototypes and mock-ups so that they could be validated by a selected group of technical staff, experts and a small number of end-users. A large part of this phase was dedicated to the study of the graphics for the user interface of the Smart Vending machines.

Initially, the information to be offered through the touch screen of the Smart Vending Machines was structured in an architectural diagram. A number of rough graphic prototypes were then developed in a set of diagrams in order to understand how to best present this information to the user throughout the navigation of the interface, to best ease the customer experience.

Figure 6: Scenes from the Exploration phase

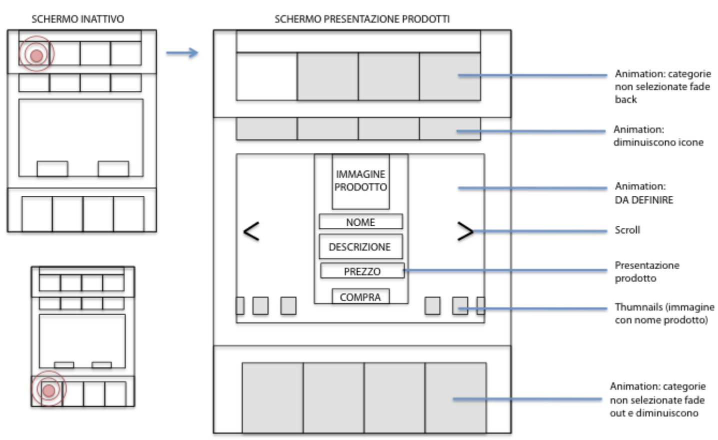


Figure 7: Diagram studying interactions and information architecture for the Smart Vending Machines

All features of the user interface were analysed by the research team of the City of the Future Living Lab. Tiresias Guidelines developed for screen-based graphics by the Royal National Institute for the Blind were implemented in order to create a graphic layout which is easy to understand and read by an extended majority of people. Fonts, typeface dimensions, thicknesses of lines, colour combinations, distances between elements and sizes of images and icons were all rigorously designed and tested in order to validate them.

Figure 8: Screen shots illustrating the development of the graphic user interface

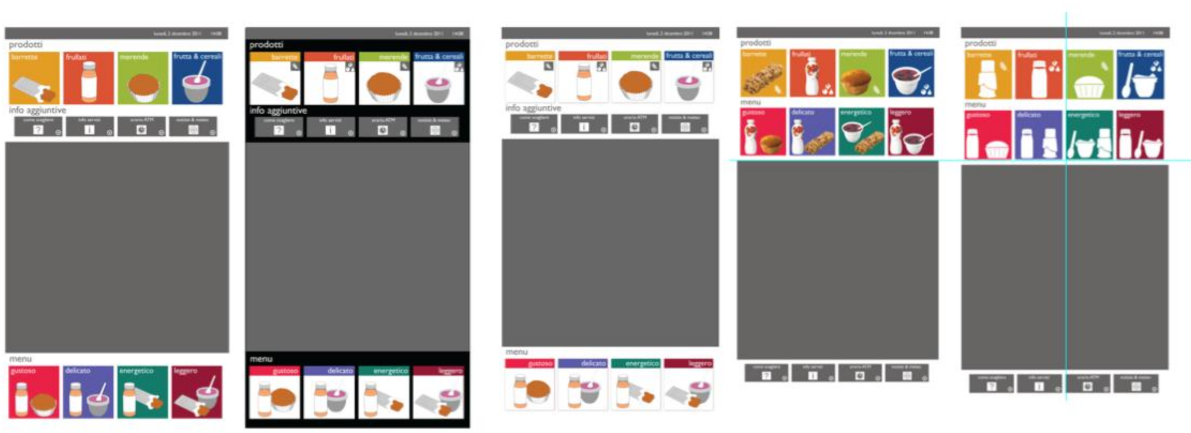


Figure 9: Study of User Interfaces during the exploration phase

Figure 10: Final User Interface proposals for the Smart Vending: icons and fonts designed to be easy to recognise and read, simple to understand communication of the services offered, approachable viewing of the products offered

4.2.3 *Expectations for the Experimentation phase*

Three different sub-phases are being planned to be included in the Experimentation Phase of the Personalised Services Scenario.

The first phase foresees the opening to the public of the temporary store in which the Smart Vending Machine will be installed. Visual material posted on the walls and presented via the screens of the vending machines will introduce users to the services offered. Users will be observed by a researcher who will verify how many people cross the space, how many stop to look at it, and how many actually enter it and buy something, whilst the technology embedded in the machines (the video camera) will monitor the sort of users who approach the vending and how the buying process is completed and how many failed attempts there are. The aim of this phase is to understand the impact of the Personalised Services Scenarios, how easily users decode the Smart Vending Machines and whether their features (touch screen and added services) are enablers or barriers, as well as confirm the personas and customer journeys hypothesised in the co-creation phase.

The second phase will analyse in more detail the efficacy and usability of the Smart Vending machine user interface. Recruited users will be asked to interact with the Smart Vending machines and then answer a short questionnaire composed of closed and qualitative questions.

The third sub-phase of the Experimentation Phase of the Living Lab process will involve the shadowing of users experience with the Smart Vending Machine with the aim of mapping the customer experience. A team of researchers will observe users interacting with the Smart

Vending Machines, collecting both visual (video and photo) and audio material, and will involve users in a longer questionnaire based upon open and qualitative questions. This phase will further substantiate both personas and customer journeys but will most importantly provide authentic feedback on the machines, their services and their user interface, thus providing the City of the Future Living Lab team information on how to best optimise the scenario.

4.3 Tourism Service Scenario

The tourism service has already undergone a first cycle of living lab before its insertion in the Elliot project.

All research activities carried out during this first cycle brought to the development of the Vainbici.it portal as well as of a Smartphone application for the sharing of journeys, GPS tracks, and location of geo-referenced Points of Interest.

Figure 11: The Vainbici Web Portal

Figure 12: The Vainbici's BCTracker App for iPhone

The experimentation phase consisted in the involvement of the community using the portal in the testing of a number of applications and devices, such as during the "Maratona des Dolomites" event that took place in July 2011.

Figure 13: Marc Wilikens from JRC at the finish line of Maratona des Dolomites 2011, where he tested HSR's BC Tracker and Smart Plaster

At this moment in time the co-creation phase is about to commence where new services designed for the portal, new devices for health monitoring and new apps will be fine-tuned.

Figure 14: Devices for physical activity monitoring (new and past version)

As soon as the Elliot platform is sufficiently structured, HSR will be able to understand where to insert the client's access to the middleware. The research team is particularly interested in exploring new applications in development compatible with Android OS.

4.4 Public Transport Scenario

HSR has completed the co-creation phase of the Public Transport Scenario as well as its exploration phase. At the moment, the research team is implementing the service related to the scenario in preparation of the experimentation phase.

4.4.1 *Co-creation – user identification, requirements elicitation and cluster analysis*

The co-creation phase began with the identification of both users and stakeholders involved in the Public Transport Scenario of HSR, as well as their needs and requirements, through direct interviews and cluster analysis. It was possible to identify the following principle stakeholders and users:

- HSR patients and visitors: all patients receiving treatment within the hospital and all people accompanying or visiting them;
- HSR personnel: doctors, nurses, receptionists and other personnel working in HSR;
- IRIS - Innovation & Research in life and health Services Unit: a department inside HSR, responsible for generating and proposing potential innovations to improve life and health services in the hospital;
- HSR Customer Service: office within HSR, which deals with customer relation management.

Other indirect stakeholders identified include Regione Lombardia (the Municipality of Lombardy which is the Italian Region where HSR is located), and the Italian Ministry of Public Health.

4.4.1.1 Identification of user and stakeholder needs

The research team interviewed 128 patients and visitors of HSR within the hospital structure. Each interview had two sections and lasted between 15 and 40 minutes.

The first part consisted of about 30 predefined questions with closed answers and had the aim of identifying users' needs regarding their Mobility. The second part was an open-question session and had the aim of gathering interviewees' personal opinions and experiences related to their Mobility in the hospital grounds as well as suggestions for possible improvements. The pie chart below illustrates the main areas that users interviewed felt were in need of the most improvement.

FONDAZIONE SAN RAFFAELE
MONTE TABOR

ALTA SCUOLA POLITECNICA
POLITECNICO DI MILANO
POLITECNICO DI TORINO

Miglioramento Mobilità e Accessibilità hSR

Questionario compilato in data:
Alle ore:
Luogo di compilazione:
Tipologia di raccolta:

Buongiorno, sono del Politecnico di Milano/Torino, in collaborazione con hSR.
Le chiedo alcuni minuti del suo tempo per compilare il seguente questionario, che sarà del tutto anonimo.
Questo questionario ha la finalità di analizzare il livello di gradimento dell'organizzazione dell'ospedale in relazione a mobilità e accessibilità interne, per permettere una ricerca sull'ottimizzazione del servizio offerto.
I dati raccolti verranno trattati in forma aggregata ed anonima.
La ringraziamo per la Sua collaborazione.

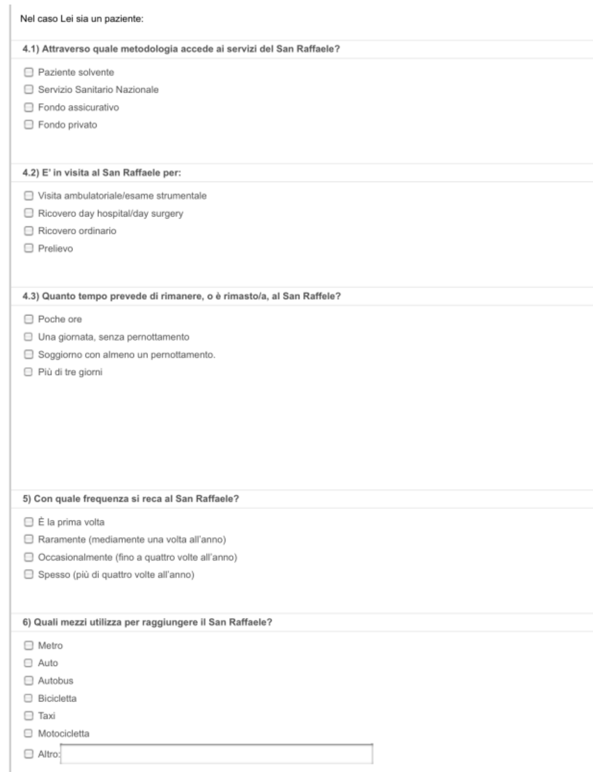
PARTE 1: ANALISI DELL'UTENZA

1) Dove risiede?
- Milano
- Provincia di Milano
- Lombardia
- Fuori regione

2) Qual è la Sua età?
- 0-17
- 18-39
- 40-64
- 65-74
- 75 +

3) Qual è il Suo livello di istruzione?
- Licenza elementare
- Licenza media
- Diploma
- Laurea

4) È in visita al San Raffaele come:
- Paziente
- Visitatore/Accompagnatore
- Altro:



Nel caso Lei sia un paziente:

4.1) Attraverso quale metodologia accede ai servizi del San Raffaele?
- Paziente solvente
- Servizio Sanitario Nazionale
- Fondo assicurativo
- Fondo privato

4.2) E' in visita al San Raffaele per:
- Visita ambulatoriale/esame strumentale
- Ricovero day hospital/day surgery
- Ricovero ordinario
- Prelievo

4.3) Quanto tempo prevede di rimanere, o è rimasto/a, al San Raffele?
- Poche ore
- Una giornata, senza pernottamento
- Soggiorno con almeno un pernottamento.
- Più di tre giorni

5) Con quale frequenza si reca al San Raffaele?
- È la prima volta
- Raramente (mediamente una volta all'anno)
- Occasionalmente (fino a quattro volte all'anno)
- Spesso (più di quattro volte all'anno)

6) Quali mezzi utilizza per raggiungere il San Raffaele?
- Metro
- Auto
- Autobus
- Bicicletta
- Taxi
- Motocicletta
- Altro:

Figure 15: Images of the questionnaire with which user needs were identified

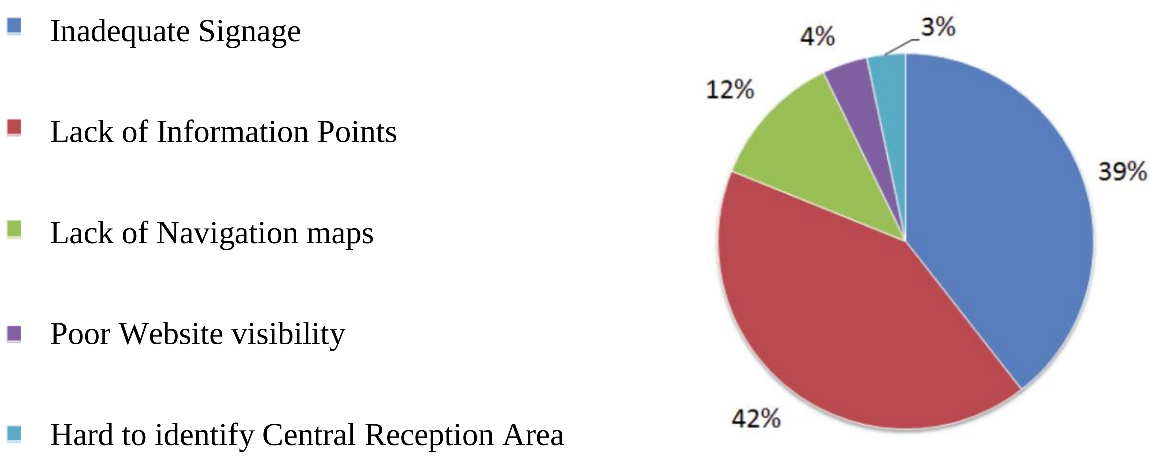


Table 5: Pie chart representing user requirements concerning their mobility around HSR grounds

A Pareto Diagram was derived from the data and the results show that the main criticality identified by users is the scarce number of information points at the Central Reception Area:

only one out of ten counters is dedicated to providing information. The other two relevant criticalities relate to the sparse number of signs, and the fact that often signs do not properly clarify the direction to be taken.

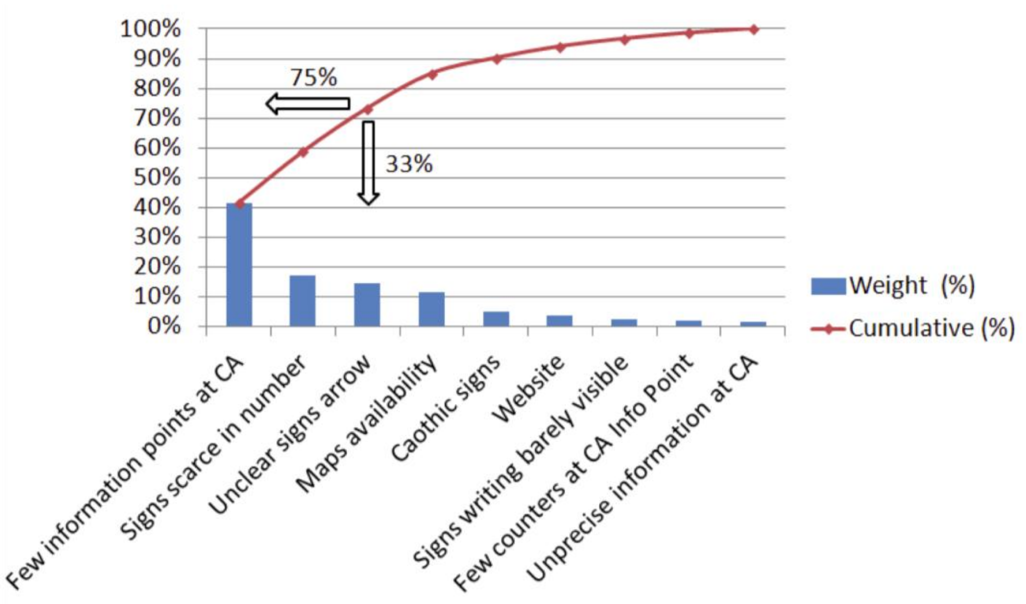


Table 6: Pareto Diagram that illustrates the top pain points

An analysis of the feedback collected for each set of questions of the questionnaire was also completed. For example, the analysis of answers to questions 1 and 2 in section 2 showed that users had issues regarding waiting times in the Reception Area: the vast majority of users (51,5%) identified that the main cause for the long waiting times was the absence of enough counters.

	Not relevant (pt=0)	Little relevant (pt=1)	Rather relevant (pt=2)	Very relevant (pt=3)	Total score (pt*occur)	Weight
	number of occurrences for each answer					
Waiting times	90	16	12	6	58	29.7%
Information availability	83	21	15	5	66	33.8%
Passageways organization	78	23	21	2	71	36.4%

Table 7: First level analysis of interview data.

Answers to the questions in section 2.2 were also further analysed. What emerged is that users found it hard to identify the correct parking lot, and found it difficult to reach the entrance of the hospital from it. Further investigation with interviewees showed that the main issue lies specifically with the free parking lot, which is considered to be very distant from the main hospital entrance.

	Weight of the related second-level cause	Score of the third-level cause	Final weight
Signs scarce in number	39.4% (Inadequate signs)	43.4%	17.1%
Unclear sign arrow		36.8%	14.5%
Chaotic signs		13.2%	5.2%
Signs writing barely visible		6.6%	2.6%
Few counters at Central Acceptance (CA) Info point	3.3% (CA Information Point)	57.1%	1.9%
Imprecise information at CA		42.9%	1.4%
Few information points	41.7%	-	41.7%
Maps availability	11.7%	-	11.7%
Website	3.9%	-	3.9%

Table 8: Computation of weights for third-level causes of the first-level cause "Information availability".

An overview of the pain points identified as a result of the answers to the questionnaires is illustrated below:

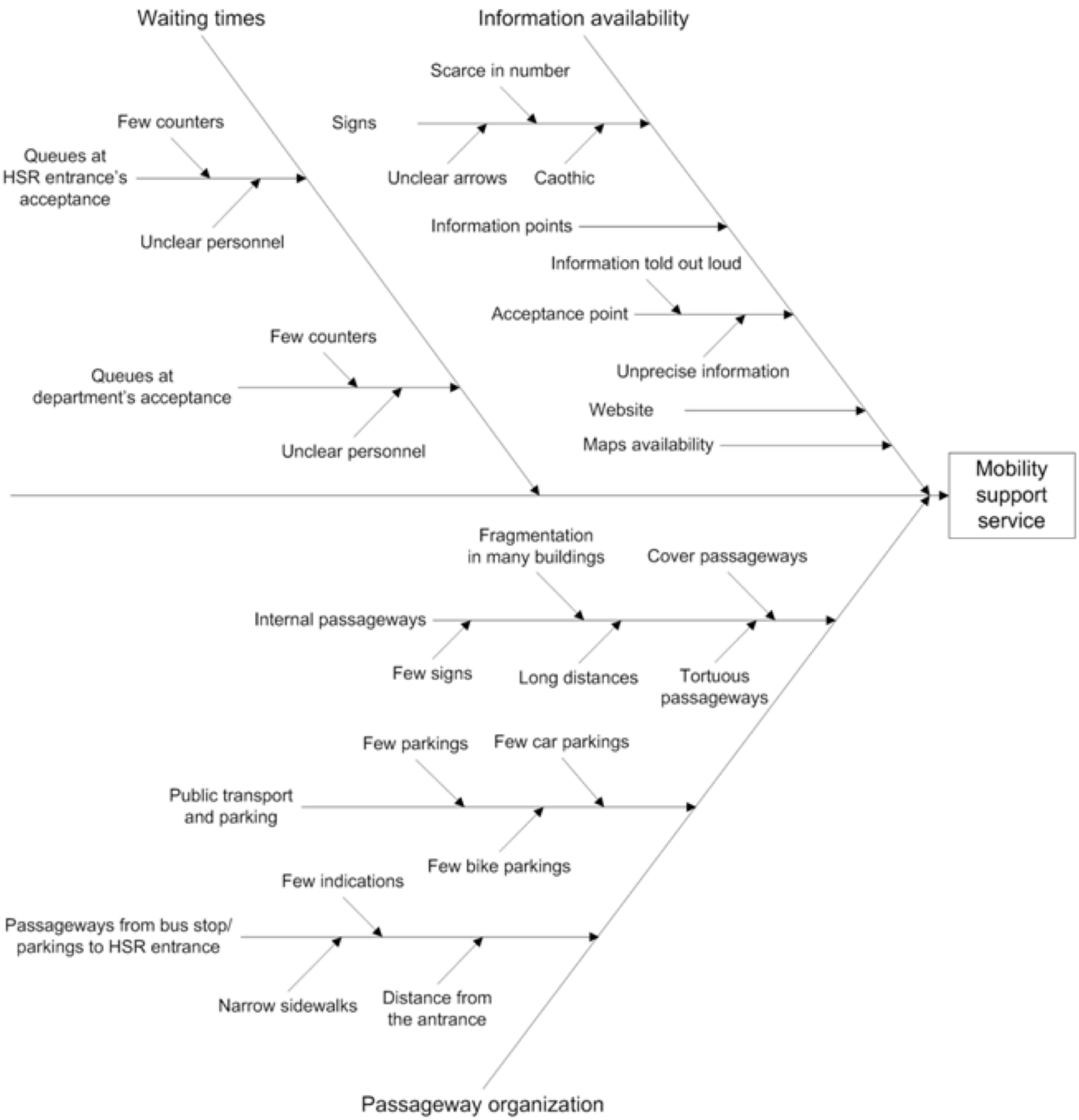


Table 9: Fishbone diagram

4.4.1.2 Cluster analysis

In addition to the interviews, the HSR Research Team explored user pain points through a Cluster analysis, in order to determine distinct user attitudes or behaviours. A set of criteria was determined in order to segment profiles and to better evaluate the attractiveness of future new solutions:

- How familiar users are with technological devices;
- How familiar users are with the hospital's layout;
- How users reach the hospital.

By crossing the above criteria and adding additional criteria regarding user mobility, the following clusters of HSR patients/visitors were identified:

1	Individuals with a good technological attitude, accessing the hospital via public transportation, and who are familiar with the hospital's navigation system
2	Individuals with a good technological attitude, accessing the hospital via public transportation, and who are not familiar with the hospital's navigation system
3	Individuals with a good technological attitude, reaching the hospital by car, and who are familiar with the hospital's navigation system
4	Individuals with a good technological attitude, reaching the hospital by car, and who are not familiar with the hospital's navigation system
5	Individuals with a poor technological attitude, accessing the hospital via public transportation, and who are familiar with the hospital's navigation system
6	Individuals with a poor technological attitude, accessing the hospital via public transportation, and who are not familiar with the hospital's navigation system
7	Individuals with a poor technological attitude, reaching the hospital by car, and who are familiar with the hospital's navigation system
8	Individuals with a poor technological attitude, reaching the hospital by car, and who are not familiar with the hospital's navigation system
9	Individuals who move in wheelchairs or mobility aids
10	Individuals who are blind or visually impaired

4.4.1.3 Conclusions of the analysis part of the co-creation phase

The identification of the users and stakeholders involved in the Public Transport Scenario of HSR and the study of their "pain points" in relation to the way they interact and move about the hospital grounds, made it possible to identify some distinct areas that need improvement as well as opportunities in which to innovate. The most relevant pain points and opportunities are:

- Lack of effective and adequate signage system and therefore the opportunity for an improved navigation system to support users' mobility within HSR;
- Difficulty in identifying parking lots and ways of reaching the hospital main entrance from these, as well as costly rates, and therefore the opportunity for an improved parking system where users feel empowered (whilst taking into consideration price reduction);
- Long waiting times at the Main Reception and therefore an improved Reception area layout with improved information delivery points.

4.4.2 *Co-creation – idea generation and identification of possible solutions*

In order to ideate and delineate possible solutions to the needs and opportunities for innovation identified by the feedback provided with the previously mentioned questionnaires, a series of brainstorming sessions with a randomised selection of users from the previous research wave were held.

The HSR research team guided these sessions. Each pain point was presented to the participants of the groups, as well as a number of state-of-the-art existing products and services as stimulants. Via a series of open discussions, disruptively innovative and technology-based solutions were identified and explored in depth.

4.4.2.1 Solution 1: InfoTotem

The InfoTotem solution is a kiosk that can provide a variety of services to users, and has the aim of both improving their navigation of the hospital grounds, as well as reducing queuing times (for examples users can access a personalised account through which they can retrieve tailored and sensitive data). These kiosks should be equipped with touch screens, must be suitable for outdoor use as well, and must be positioned at the most important convergence nodes.

Users communicated the need to retrieve personal and sensitive data in a quick manner, other than via the counters at the Main Reception Area. For this reason, it was suggested that users should be able to access such data by inserting their "Carta Regionale dei Servizi" into the InfoTotem (a unique and personal chip-enabled card issued by each the Municipality of Lombardy).

Figure 16: An example of a way in which users can interact with kiosks via a health card for the access of confidential information

Another issue identified by users was their difficulty in navigating HSR hospital's grounds. For this reason it was decided that the InfoTotem should support user in finding their way via a "Path Calculation" service: the user can identify him/her-self by inserting his/her health card into the kiosk. The system recognises the user and displays the destinations correlated to the user profile (based upon his/her previously booked appointment). The user can subsequently select the desired destination and have the direction to reach it illustrated by the kiosk in an intuitive manner. If the user is a visitor or the destination is different from the one saved on the health card, the user can manually type the correct destination via a digital keypad.

Figure 17: A kiosk that supports user navigation

Users also recognised the need to book health visits and exams in a faster way, as an alternative to more time-consuming communication channels (i.e. telephone or the internet). For this reason the InfoTotem must also offer users the opportunity of booking both visits and examinations in the HSR, and must be as in line with the hospital website. Therefore, the kiosk must display a graphic interface that includes a keyboard interaction, and a timetable with easy-to-read dates, days and times. Users also requested the possibility of printing a reminder with the details of the visit directly from the kiosk during the brainstorming sessions, as well as the possibility of accessing the appointment to modify or cancel it. Users also expressed the desire to visualise, print or retrieve exam results via the kiosk, always by inserting their health card in the kiosk card reader.

Technology-oriented users found it interesting and useful to be able to download content from the kiosk onto their mobile phones and devices via Bluetooth. Such content could be informative (for example, HSR clinic specialties list) or even recreational (for example, newspaper articles or newscast videos). Generally all users found that payment for hospital related services (such as parking but also hospital visits and exams) would be made easier by the InfoTotem via cash and credit cards, as well as the opportunity to purchase prepaid cards to be used in the cafés or shops located inside the hospital grounds. Such services could be a very effective way to trigger users into using such terminals: for example, parking could be cheaper if paid for via the InfoTotem, or it could be possible to get "special offers" in buying shop or café prepaid cards.

To conclude, seven functionalities were identified as important to be offered by the InfoTotem as a result of user discussions throughout the brainstorming sessions:

- Person identification;
- Path Calculator;
- Booking of visits/exams;
- General document printing;
- Content download;
- Payment;
- Parking support service.

Figure 18: A visual representation of the InfoTotem concept

4.4.2.2 Solution 2: Smartphone application

Smartphones are becoming ever more accessible to the majority of people. They are a personal and fast access channel to a number of services including telephoning, emailing, multi-protocol wireless communications, and PDA capabilities. They are becoming an effective way of interacting with mixed real-virtual environments, and the brainstorming groups acknowledge the strong potential of a Smartphone Application as a solution to the mobility issues identified during the first wave of interviews. Smartphones' strong points identified by the groups are numerous and include their ability to reproduce relevant data at all times and from all locations (the importance of an internet connection was strongly underlined), their ability to transmit the owner's location and to converge a number of different devices into a single small and portable device.

The second solution that emerged from the brainstorming sessions involving users foresees a multifaceted Smartphone Application that can be used on its own or as an additional service to the previously described InfoTotem.

One of the first services users felt the Smartphone Application could offer them is as a supportive tool to traditional booking channels for exams and visits in the HSR hospital. Users hypothesised that the application could send them a reminder of the visit or test booked previously online or via phone the day before the visit, and upon arriving to the hospital the application could recognise their mobile device and send them relevant data (for example location of the office where the exam or visit was booked, or the name and internal number of the doctor). Alternatively, visitors or patients can retrieve the same sort of information by pairing their device to the Terminal Unit and download the application as well as relevant information. Knowing whether a patient has arrived at the hospital could also be useful to the hospital team in scheduling visits and assigning rooms to doctors and avoid booking staff, medical equipment and rooms unnecessarily.

Users involved in the brainstorming groups also suggested for the Smartphone Application to act as an additional channel through which to pay for a number of HSR services, from the parking lot to the light rail train, from visits to exams, thus minimising queues as well as receipts. Nevertheless, though the potential was very much recognised, users are still worried by digital payments methods and feel the need of adequate information and transparent documentation. Numerous studies have tackled the problem of digital payments and NFC technologies seem to be a good solution for the future. At the same time, Smartphones often have a good screen resolution that allows the use of 2D scanners to read bar-codes, which could be a solution in the near future.

The need for easing finding the way within the hospital's layout was another feature that users felt was necessary to be included in the Smartphone Application solution. Users suggested being able to access a hospital map via their Smartphone, or even retrieve real-time directions on how to reach a specific location (as mentioned previously the application could recognise the user via his/her phone and according to the examination appointment or visit booked, could send the user the necessary directions to reach the desired location). For example, visually impaired or partially sighted users could access such an application and receive voice indications of how to reach their appointment. Should the user become lost, or should users with mobility impairment need assistance, for example, the application could allow him/her to ask for help or support. Another suggestion was that as the user is moving across the hospital grounds, the application could signal the presence of points of interests (such as toilets, the supermarket, Info Points, InfoTotems, etc.) as well as the most accessible routes. This could also be a way in which to advertise volunteer initiatives, open-to-public cultural events, but also the business tied to the hospital such as the shuttle service or the hotel.

Figure 19: A visual representation of the Smartphone concept

The following list is a breakdown of the functional characteristics that the users felt were to be offered by the Smartphone Application:

- Ability to ID the user;
- Ability of receiving SMS Alerts;
- Ease of Payment;

- Way finding support;
- Ethic proximity marketing;
- General offering of Services;
- Support for Physically impaired users.

4.4.3 *Exploration*

The solutions were explored by users through the completion of a questionnaire, in order to identify which concepts the research team needed to develop further. Indeed, the InfoTotem and Smartphone Application had numerous features and characteristics in common and both could equally help at improving users' mobility around HSR's grounds.

The exploration was based on the following criteria:

- Resolution of users' mobility problems;
- Appealingness to users;
- Applicability of the solutions to the different clusters;
- Sustainability.

The interviews conducted not only gathered user requirements, but also tested the popularity of the solutions among users. At the same time, some questions were useful to understand users' perception of mobile and credit card payments, a functionality that both solutions have in common. The results are summarised in the table below.

The most appealing solution is the InfoTotem, since 84% interviewees rated it as "Useful" or "Very Useful". Out of the two solutions it appears to be the most intuitive and does not require particular skills from the user. The Smartphone Application evoked less enthusiasm among users, even if the majority of them found it useful and interesting. Mobile or credit card payment received a poor score and was rated "Not useful", and therefore must be considered a marginal functionality for both solutions.

Another important criterion of evaluation of the two solutions is the analysis of the clusters supported by the solutions. The discriminating element appears to be users' technological attitude, alongside their age as a proxy (see Table 13), whilst the other two were not: indeed, both solutions address the needs of people who are not familiar with the hospital grounds and both respond to the needs of individuals travelling by various means of transportation.

Criticality	Terminal Units	Smartphone Application	Rationale
Scarce and unclear signs			Both solution compensate signs inadequacy supporting mobility through technology.
High prices of car parks			Both solutions comprehend the possibility of offering parking price reduction, but the impact on fees would be marginal.
Queues at CA			The Smartphone application would reduce queues in absolute terms, while Terminal Units would transfer part of the queues from info points to kiosks.
No support for visually impaired people			The smartphone application could support visually impaired mobility through voice speaking information.
No wheelchair at disposal			The smartphone application could help wheelchair users find a suitable path, even if would not help to provide wheelchairs when needed.

Table 10: Results of the questionnaire regarding concepts' appeal

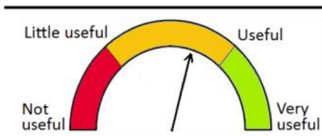
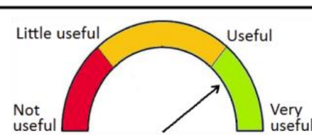
Information through Smartphone apps	Download of maps from Terminal Units in hSR	Park payments with mobile phones or credit cards
		

Table 12: Results illustrating the most popular features

	Average	0-17	18-39	40-64	65-74	75+
Interested people	57%	100%	60%	60%	46%	40%

Table 11: Percentage of interviewees rating the Smartphone solution as "Useful" or "Very useful"

The further comparison on behalf of the research team between the InfoTotem solution and the Smartphone Application solutions led to the following considerations on the sustainability of these solutions:

- Mobility is supported by the kiosks via the possibility of printing the path selected by the user, whilst the Smartphone application provides all the information on the display of the device. Therefore, the Smartphone Application allows for a paperless solution to the problem of mobility;
- Smartphones enable mobile payment, whilst kiosks do not. This too reduces paper waste (i.e. with e-tickets and e-receipts);
- The InfoTotem requires the installation of at least fifteen kiosks within the hospital, which implies high levels of investment and resources. On the other hand, the Smartphone Application adds functionalities to a device that is already owned by the user, which obviously requires fewer resources;
- The InfoTotem has a low technology impact on users, and younger users appeared to prefer the Smartphone Application over the InfoTotem solution whilst older users did not find the latter appealing. Nevertheless, over time it is believed that technology knowledge will become increasingly pervasive.

5 Green Services [INRIA-FING-VuLog]

In this document the green services exploration are reported on and co-creation workshops performed until December 2011 according to the methodology presented in D4.2.1. The focus of these workshops was air quality and mobility. Exploration sessions were inserted within the co-creation workshop i.e. during the 3 hour workshops.

For logistical reason, participants met in two places: Nice and Sophia Antipolis. As a consequence co-creation sessions were run twice, apart from the last session that was only performed in Sophia Antipolis with a very limited attendance. Date and duration of the workshops are detailed in Table 1 below.

Location	Inspiration/Exploration session	GenIOT debriefing and Aloha! session	Prioritisation and fine tuning session
Nice (public structure promoting the usage of internet for all citizen)	28/11/11 3h00	12/12/11 3h00	N.A.
Sophia Antipolis (INRIA premises)	25/11/11 3h00	7/12/11 3h30	19/12/11 3h00

Table 1: Green Services Workshop (first batch focusing on Mobility)

Participants to the green services workshops were volunteers recruited via the ICT Usage Lab network and were asked to fill the online questionnaire (cf. the French version on http://www.ictusagelab.org/content/devenir-co-cr%C3%A9ateur-dans-le-projet-elliot) in order to create a composite group in terms of demographics, attitude towards ICT, usage of ICT, attitude towards sustainable development, and knowledge on air quality.

The overall sample for the face to face activities comprised 13 participants.

As detailed in the report generated by Focuslab server of the ELLIOT platform, participants are a composite sample of the local population, consistent with most features listed as relevant for our workshops (cf. Appendix 1), except for the profession, age and attitude towards sustainable development.

In the following the participants are referred to by indicating their subgroup: SA for Sophia Antipolis and N for Nice and mention the total number of participants; for instance SA(5) related to 5 participants from the people who met in Sophia Antipolis. Their occupation, gender or any other parameter is only referred to when relevant.

The next section presents the collected data (from raw data to pre-processed data) inside the living lab during the workshops which cover both exploration and co creation sessions. Note that during the workshops, no data from real sensors was collected.

An analysis was made of collected data manually inside the living lab or in some cases, with the support of Focuslab server for more advanced pre-processing such user session structuration, user actions analysis, etc. Results of these analyses are stored inside the Elliot platform.

5.1 Collected data

Raw data collected cover:

- Video recordings of the exploration sessions
- Raw data of the face-to-face co-creation sessions
    1. Video recordings and partial transcription of the corresponding audio track of the face to face co-creation sessions
    2. Logs from customised Ideastream tool used for the online co-creation (online part of the GenIoT method)

5.1.1 *Sensor data collected during the workshops*

During the workshops we performed, data from real sensors was not collected. During the exploration workshop, participants were invited to use applications offering the results of data collected by real sensors or from simulators. During the co-creation workshop fake sensors were used. Sensor data (green watches, electric-based sensors) are collected only in the context of testing the green service portal in development.

5.1.2 *Data collected during the exploration sessions*

Most exploration sessions were video recorded. Records involve from 1 to 3 camera(s) (fixed or handed) and cover mainly medium long shots. Length of the recordings and numbers of participants actively involved in the individual or collective exploration are summarised in Table 2.

Prototype, service or concept explored	#Participants N=Nice	Length of the recording	Type of exploration
Atmopaca site	N(8)	22min 35sec	Collective
Noise tube (from map and video)	N(8)	6 min	Collective
Ford sync and pollen	N(8)	4 min	Collective
NiceAir on Samsung Tablet	N(1): artist	13 min	Individual
NiceAir on Samsung Tablet	N(2): nurse, and ICT facilitator	17 min	Collective

Table 2: Overview of the video recording for the exploration sessions

5.1.3 *Data collected during the co-creation sessions*

Two types of sessions are performed by participants during the co-creation step: face to face co-creation sessions (with Aloha! And GenIoT methods) and on-line sessions with Ideastream (with GenIot method) tool.

All face to face co-creation sessions were video recorded (hence a total of approx. 14h 30m).

The audio track of the following sequences was as well transcript for further analysis:

- The GenIoT idea debriefing, where participants explain the idea behind the picture they have posted, and possibly build on each other's idea.
- The enactment of the scenario generated during Aloha! networking.
- The final session levering emerging ideas, identifying criteria for service prioritisation and fine tuning a service.

Size of the transcript is roughly indicated in Table 3.

Type of face to face co-creation method	Number of words[5]
GenIoT idea debriefing	13062
Aloha! scenario performance (networking phase excluded)	6707
Prioritisation and fine tuning session	34277
Total	54076

Table 3: Volume of the transcript of the face to face co-creation sessions

[5] Numbers are provided only to give a global idea of the size of the transcript. All words were counted (included the initials of the speaker).

Running of the GenIoT method generated as well data stored in the customised Ideastream. The collected raw data are issued from ICT Usage lab Web server and from the Ideastream database. Web Logs from the 25/11/11 to the 19/12/11 were pre-processed for the analysis.

First here is an example of a line from Ideastream log according to the ECLF (Extended Common Log Format) format (cf. deliverable D4.2.1 IL1-IL4 indicators) :

```
138.96.198.241 1 - [12/Dec/2011:11:04:19 +0100] "HTTP/1.1" 302 -
"http://www.ictusagelab.org/IDEASTREAM/node/139" "Mozilla/5.0 (Windows NT
5.2; WOW64; rv:8.0) Gecko/20100101 Firefox/8.0"
```

```
With IL1= 1

IL2= POST /IDEASTREAM/node/139?destination=node%2F139

IL3= 11:04:19

IL4= 12/Dec/2011
```

As shown in Table 4, first the logs related to the use of our Ideastream tool are extracted from Web logs of the ICT Usage lab Web server. Then the logs are cleaned by deleting irrelevant lines in terms of user actions, mainly server actions such as redirection (lines having 302 as request status) or actions of non-participants (administrator, etc.) by using the table watchdog of the Ideastream database (IP, users). The second parameter of an ECLF line is added with the user corresponding to the IP in each line of our file.

Web Logs	Size	Lines
ICT Usage Lab Raw data	35681098 bytes	147871
Ideastream Raw data	247416 bytes	10126
Cleaned Ideastream Raw data	824920 bytes	2874
Number of participants	8	

Table 4: Volume of Web Logs

In order to enrich Web logs analysis, 7 tables of the Ideastream database are also used (as shown in Figure 5) to address the user actions offered by this tool: posting an idea, posting a comment, etc.

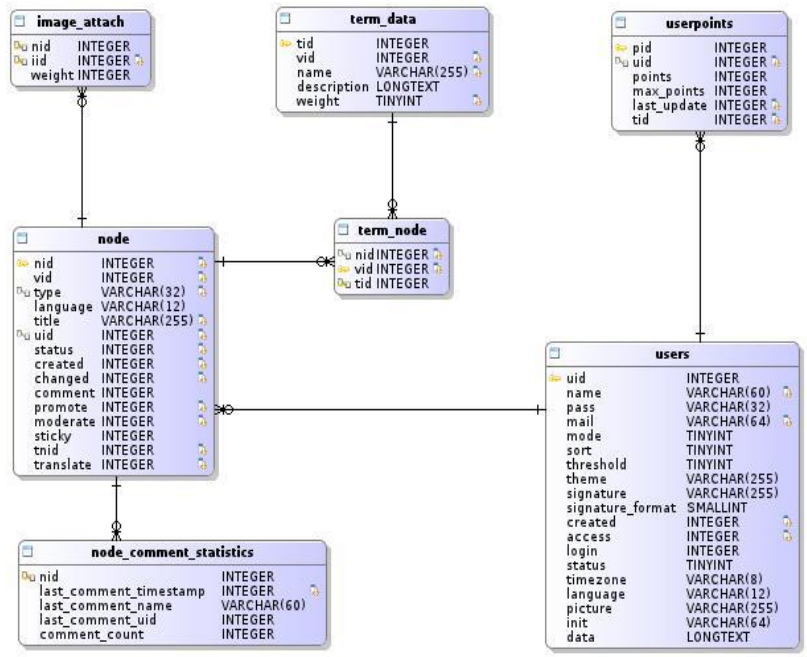


Figure 5: Part of the Relational Schema of Ideastream database

Publications of GenIoT ideas cover the following fields (mainly from the "NODE" table as well as the others shown in Figure 1):

- Author of the idea (login)
- Title of the idea (as per user definition)
- Time stamp
- Tag
- Picture(s) related to the idea
- Legend of the idea (text)
- Comments on the idea
- Internal/external/hybrid IoT system

5.2 Analysis of collected data during the exploration sessions

A qualitative analysis was made based on video recording related to the discovery of five services or prototypes as described in D4.2.1:

- Atmopaca web site (http://www.atmopaca.org)

- Noise Tube
- Green Watch
- Nice Air: mock-up developed in the AxIS team during the first step of the project for supporting the exploration step (cf. D4.2.1)
- Ford Smart Car

The objective of the analysis of the exploration session is to feedback user experience in order to help specifying the green services to be experimented.

5.2.1 *Summary of Atmopaca group discovery*

The discovery of the atmopaca.org site led to the identification of the following learning points (to be considered in the listing and weighting of the green services portal requirements):

- A home page showing an aggregated index of air quality on a map is a good way to attract user for the service (teaser effect, heat maps are even more appreciated as they also present an aesthetic value).
- However further information on the air pollutant measures, thresholds and target profiles to which they relate are required after the broad view.
- Map at the street level is needed by the users of the service as they want to identify specific area within the town.
- People need to have a double legend referring both to the abbreviation and the chemical notation of the gas.
- Localising the sensor used for producing the measure is an important feature (that could be inserted on the map). However the green service should also educate users on the added value of the mathematical modelling (vs. sensor driven measuring which is the default interpretation) and the complementarily of the 2 approaches. After some exploration of the Atmopaca service, participants expressed the need to visualise the positioning of the sensors. The number of sensors (and not type or position in terms of height or air circulation) is considered as related to the reliability/confidence level of the measure displayed. People do not know the mathematical modelling of air pollution and are not aware on the chemical reactions taking place in the air. They tend to approximate the validity of the measure displayed by counting the number of sensor in the vicinity of the target place.
- Within public communication domain, environmental specialists advise to speak in

terms of air quality (positive connotation) vs. air pollution (scarying notion). However, the scale for measuring of the air quality is counterintuitive as air quality is inversely proportional to the rate of air pollutant. As a consequence the better air quality is, i.e. higher on a 10 points scale, the lower are the pollutants or, as expressed by some participants the "more air" there is (i.e. unpolluted air). Colour coding of the scale helps in facing this problem. However most participants were puzzled by this approach that requires some thought before understanding.

- Alert features were appreciated: the email alert, providing that it is not triggered very often (i.e. avoid a spamming effect), was considered as an added value service.
- Consultation of a history of measures was mentioned only by a few participants and corresponds only to a "nice to have" feature: providing local and instantaneous measures (as well as forecast) would be the main asset for a green service portal.

Green service portal Feature	Service Design Recommendation
Home page	Place the air quality/pollution map with aggregated index directly in the home page as default choice
Home or Second level page	Do not only provide the aggregated index but also detailed pollutant maps (filter usage or second level page) and explicit the validity of the threshold/legend
Micro-level map of air pollution	Must have
Double notation (O3, Ozone notation)	Must have
Sensor localization on the measurement map	Nice to have
Air quality index	If the Atmopaca index is used, its name and visual representation cannot be change (for consistency reasons). It another index is built, it could be called air pollution index.
Email alert	Must have (killer app of the GS portal?)
Measurement history	Nice to have (for non-professional usage of the platform)

5.2.2 *Summary of Noise Tube group discovery*

Exploration of the Noise Tube IoT service highlighted a dual positioning on noise distributed measuring. On one hand noise measurement was considered as not being an issue as the noise levels can be intuitively predicted (noise related to works on the street, traffic, neighbours etc.) and human beings have built in sensors for noise measuring (the ears), which is not exactly the case for air pollution (even if the nose and eyes are relevant human sensors as well). Most participants, placed in an individual perspective -I produce my measure for myself- had difficulties in finding a *benefit* in such a service. However they reckon that the *knowledge* generated by such a service could be used for asking for law enforcement or defending oneself against false accusations of noise pollution. One the other hand, some participants understood that the value of such an IoT system comes from its *social* usage, i.e. from producing a measure for the others and in return, using and trusting the measures produced by others. More generally, participants who are not worried about cardio respiratory problems feel more concerned by the noise pollution and the noise tube service was seen as a way to be in control and act against or at least take decisions (typically on itinerary change) based on the distributed measure. Moreover, the usage of the data produced by the individual measurements (incl. geolocalisation) was questioned. Participants needed to understand who would own and share the data and to what extent privacy would be respected.

Green service portal Marketing strategy element	Service Marketing Recommendation
Target	Promote the air quality measurement to market concerned by cardio respiratory problems and noise to the others
Marketing of the Noise measurement	Use a story telling stressing the benefits gained by accessing measures produced by others for instance for a quiet walk, or the benefits related to self-measurement for legal reasons.
Data privacy policy	Highlight all aspects of the policy.

5.2.3 *Summary of Green Watch individual discovery*

The version explored by the participant was the initial design where the green watch has to be coupled with an additional cell phone in order to display the data. *Green watch as an object does not induce a good user experience*.

All participants managed to use the watch and the phone but male participants placed both the watch and the phone next to the other, monitoring a sign of data transmission while female participants first focused on the interaction with the phone and simulated a noise. As the response rate of the green watch is very slow, most of the time participants did not notice any measurement being made.

The design of the watch was so unintuitive that all female participants, while trying to wear the watch, turned it before wearing it, in order to ensure that they were wearing it on the right side. When on their wrist, participants found it big and somewhat cumbersome. One participant explicitly mentioned that she would not wear it, even for an experiment; because she found it ugly. The facial expressions of the other female participants reinforced this opinion.

Furthermore, participants explained their reticence in wearing another device transmitting radiofrequencies; they indicated that they could not do without their cell phone but were not sure they could justify – being exposed to another potentially risky source.

Green watch as a concept also raised some concerns:

Participants not concerned by the health impact of noise and air pollution remain sceptical about the potential change in transportation behaviour related to the knowledge of the air/noise pollution. They tend to think that such criteria are not important enough (time, cost and other experience features of the transportation, such as temperature, light, feeling of freedom etc. would go first).

Other participants did not trust and/or feel competent enough in the domain of air sensing to take the responsibility to produce measures and were afraid of not controlling all usages that could be made with the measurements taken.

However, a minority of participants (younger and/or knowledgeable in sustainable development) stressed the importance of being active in producing the information and sharing it between citizens, in order not to be reliant on institutional and top down measures.

As a conclusion, very few participants volunteered to wear the green watch during the experiment.

Green watch features	Recommendations for the recruitment of people wearing the green watch
Coupling watch/Phone	Run the experiment with the new version of the green watch (standalone version)
Screen design, watch dimensions	Run the experiment with the newest version of the green watch (revised design of the watch),
Data transmission protocol	Compare the radiation from the green watch to the one of a regular cell phone in order to reinsure people fearing the impact of radiofrequency radiation on their health
Data production and ownership	Stress the anonymity on the platform and the liberty to delete own measures
Sharing data	Target students and ecological activists

5.2.4 *Summary of NiceAir individual discovery*

The main findings/recommendations from the NiceAir explorations sessions while installed on a pad are now set out (Samsung Galaxy tab 10.1). Indeed, initial explorations performed on smart phones (Samsung Galaxy S) were found hard to document as the video recording of the scene [including both participant gestures and screen] could not make it possible to precisely see the items touched or referred to during the exploration, leaving the burden of the analysis on the audio and on the fly note-taking. Further exploration/ usability guerrilla tests will be performed on smart phones so the screen format was not an issue at this level of the development.

Explorations informed the ICT researchers on various aspects of the service development going from strategic design and branding to software optimisation.

Nice Air service development item	Recommendations
Service design strategy	• Change the name from NiceAir to MobiNiceAir in order to better reflect the range of functionalities covered by the application. • Propose the pollen alert as a separate service, but do not integrate the pollen information on the map as it refers to a global indication
Software architecture	• Improve stability of the application
Interface development	• Improve panning and zooming functionality (response time and robustness) • Change the noise icon • Improve the visibility/affordance of the left slider menu or (better) remove it
Next exploration sessions	• Use real data (realistic is not enough) when testing a high fidelity mock up. • Test with application savvy and use leaders in order to complement the feedback

5.2.5 *Summary of group discovery of Ford Smart Car*

The idea of an intelligent car reacting autonomously depending on the level of pollen was not found attractive by the participants. Some of them highlighted the cultural difference between the US, where the service was demoed (on the video) and France. Indeed, the notion of the car as a private space playing the role of a second home did not match the relationship participants have with their car (for those who have one). Moreover the video showed to the participants was perceived as a commercial and therefore many of them took some distance before assessing the service. Whether the sensor would be embedded on the car or the data communicated to the car via internet from a database was not a question raised during the exploration: participants did not question the reliability of the data, they were just both surprised that such a service could already exist and wondering about the target for such a service (for which therefore they do not feel concerned).

5.3 Analysis of collected data during the co creation workshops

Analysis of co-creation workshop aims both at

- documenting and improving the IoT service co-creation methodology (incl. GenIoT and Aloha!); conclusion of such analysis will be reported in D4.2.2
- reporting on the attitude of participants against IoT and green services and building the IoT based green service to be tested; conclusion of such an analysis is reported in 1.1

In the following we start by presenting the data enrichment performed by the analysts from the raw data, then we perform three analysis.

- Chronological analysis of the online part of the co-creation workshop, in order to identify the group dynamics during the online exercise.
- Ideastream data analysis based on the online content in order to characterise the user sessions and the set of IoT based services generated and understand the correlation between ideas posted and participant characteristics. This analysis used the Web log pre-processing tool called AWLH of Focuslab server (extended with Ideastream data).
- A user experience analysis aiming at testing the usage of the KSB model as instantiated for the co creation phase in D4.2.1.

5.3.1 *Data qualification or enrichment*

Data coming from Ideastream and regarding the GenIoT ideas were enriched by the analysts in order both to gather all GenIoT related data (including post it ideas) and to add the following information:

- Group of the author (in term of preferred location for the debriefing N or SA)
- Idea title (identifier given by the analysts – different from author title)
- Way of Expression of the idea (photo on Ideastream OR text only on Ideastream or paper post it)
- Author (initials)
- Time stamp
- Mobility of the sensors (fixed sensors, mobile sensors, both types)
- Type of actuators (free text annotation, including data visualisation, type of alert or mechanical action)

- Location
    - Transportation mean/public space/home/workplace/other
- Verbatim (transcription of the explanation of the idea by the author during the debriefing
- Sensor used A colour code was used to indicate the type of fake sensor. As a consequence, the analysis of the picture allowed enriching the data by specifying for each idea, the type and number of sensors (see Figure 6).
    - Noise
    - Pollen
    - Dust
    - Pressure
    - Industrial pollution
    - Germs, Bacteria
    - Chemical pollution (COV, pesticides ...)
    - Joker

Scenarios of services played in Aloha! were as well qualified by indicating the attributes listed in the 7 scenarios as described against the following categories:

- Group of the author (in term of location of the game playing)
- Actors (in terms of type of Aloha! intelligent objects and persona)
- Sensors (cf. list above)
- Location
- Objective of the service (from the user viewpoint)
- Actuators (free text annotation)

Type of Sensors	Number of sensors
Noise	5
Pollen	3
Pollution	3
Pression	3
Bacteria	1
Total	**15**
Aloha! Scenarios (5 within Inria group and 2 within Hublot group)	7
Nb sensors/scenario	15/7=2,14

Figure 6: Types of sensors and scenarios

5.3.2 *Chronological analysis of the group posting*

The chronological analysis was first performed by comparing the date and type of posts on Ideastream and the data of email reminders. Most posts were made from 1 to 2 days before the face to face session and after email reminders. Other email reminders were not followed by any visible activity on the collaborative platform.

Figure 7 below is a screen shot obtained from the TIMELINE widget (open source development from MIT http://www.simile-widgets.org/timeline/) plugged on Ideastream in order to visualise the posts.

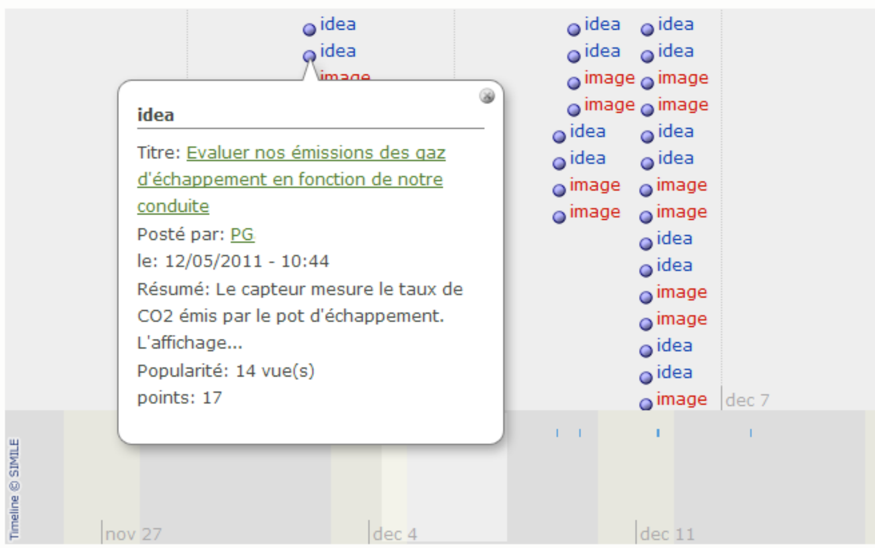


Figure 7: Excerpt of the of the GenIoT online production TIMELINE screenshot

5.3.3 *Ideastream Data analysis*

Please note that the objective for such an analysis is not to draw any generalisable conclusion from the data but rather to describe and understand the co creation process, dynamics, as well as the relation between the IoT services and the generative methods, and the geometry of the IoT services generated. Elaborated data from Ideastream data are computed by the AWLH tool (extended by Ideastream based SQL requests) from Focuslab. Eight among the 13 participants have used Ideastream as shown in the next tables. Figure 8 shows the number of visits per user (i.e. login to the Ideastream tool), the number of clicks (related to user actions), per user and the period when participants used the tool. The group of participants have made 40 visits between 28th November 2011 16:58 to 21st December 2011 18:28. We note In Figure 8 that the participant idUser=3 has the larger period of Ideastream use and the participants (idUser= 2 and

4) have the most number of visits.

IDUser	#Visits	#Clicks	DateStart	DateEnd
1	4	87	01/12/2011 16 :48	06/12/2011 08 :52
2	10	149	28/11/2011 16 :58	11/12/2011 22 :04
3	4	127	05/12/2011 20 :11	21/12/2011 18 :28
4	9	61	02/12/2011 22 :20	09/12/2011 09 :17
5	4	64	11/12/2011 13 :19	17/12/2011 21 :50
6	1	7	02/12/2011 15 :26	02/12/2011 15 :27
7	6	59	02/12/2011 09 :45	12/12/2011 15 :30
8	2	84	06/12/2011 14 :41	06/12/2011 17 :21
Total	**40**		**28/11/2011 16 :58**	**21/12/2011 18 :28**

Figure 8: Qualified data - #Visits

IDUser	#points	#ideas	#pictures posted	#tags	IoT category	#comments
IL1	/	IQ17	IQ1	IQ2	IQ9	IQ8
1	24	4	4	6	E(3) I(1)	0
2	29	4	4	19	E(4)	0
3	20	2	2	2	E(2)	0
4	21	5	6	0	E(5)	0
5	9	2	0	4	I(1) EI(1)	0
6	0	0	0	0	/	0
7	11	2	2	3	E(1) I(1)	1
8	32	6	6	0	E(3) I(3)	0
Total	**146**	**25**	**24**	**35**	**E(18) I(6) EI(1)**	**1**

Figure 9: Qualified data related to user actions

Data published on Ideastream cover a total of 25 ideas expressed by 24 pictures (2 ideas without picture and 1 idea with 2 pictures). Ideas may as well be given a title/legend, commented and voted. Figure 9 was generated from Ideastream extended AWLH database. IoT category corresponds to the category of the ideas according to the type of installation, internal (I) or external (E) or hybrid (EI). More ideas were produced during the GenIoT exercise but not published online (participants preferred to express it on a post it). These ideas were inserted in the overall GenIoT ideas description table (cf. Table 8) used for analysis. A total of 32 ideas were generated by the GenIoT method. Figure 10 provides an overview of the volume of IoT based green service ideas generated during the first set of green services workshops. Please note however that the level of maturity and richness of the services varies depending on the cases and on the method used for the generation.

Idea generation/co-creation method	Expression of the idea	Number of service idea
GenIoT	1 Picture (or 2 Pictures)	23 (1)
GenIoT	Text only	2
GenIoT	Post it	7
Aloha!	Scenario playing "on stage"	7
	Total	39

Figure 10: Volume of the IoT based green services ideas generated during the co-creation sessions

Below in Figure 11, here is the graph representing the users and the tags they share (CF. D4.2.1 IQ5 #shared tags) when posting ideas with Ideastream.

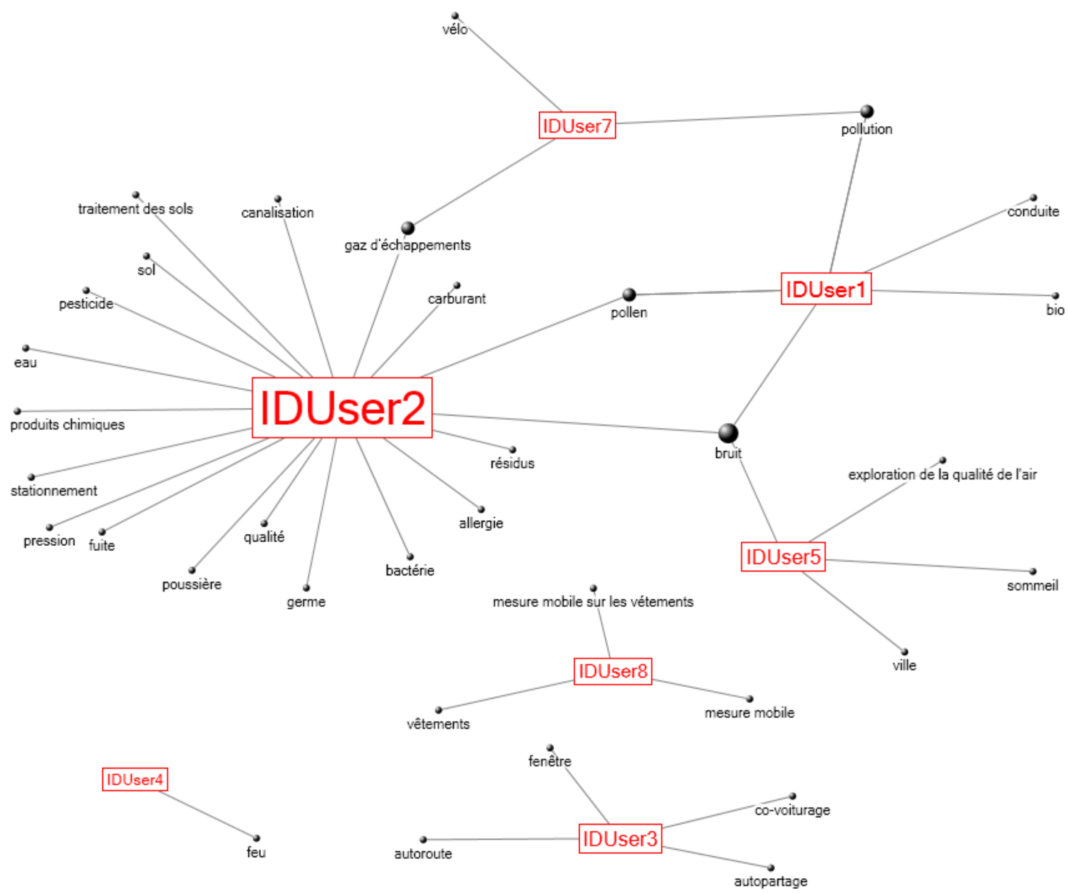


Figure 11: Graph of tags-users. IQ5=#shared tags=3

Category	Data source	Data ID	Value	Collected Data
Row data	*IdeaStreamdata (Web logs, data base)*	IL1	Figure 45 (AWLH database)	Logged user
		IL2		User action (Idea posted, comment posted, picture posted, tag posted, idea vote,...)
		IL3		Time
		IL4		Date
Qualified Data	Elaborated data from IdeaStream data	IQ1	24	#pictures posted
		IQ2	35	#tags
		IQ3	N/A	graph of who-commented-what
		IQ4	1	#comments building on a previous remark
		IQ5	3	#shared-tags (cf. Figure 5)
		IQ6	1	#ideas with more than x% participants having commenting it (e.g. x= 40)
		IQ7		frequency of site visits
		IQ8	1	#comments
		IQ9	N/A	graph of communications
		IQ10	N/A	#dyads
		IQ11	N/A	#triads
		IQ12	8	#isolated participants
		IQ13	IDUser=1	most voted user
		IQ14	IDidear=	most voted idea
		IQ15	25	#ideas (globally)
		IQ16	Figure 9	#comments per user
		IQ17		#ideas per user
		IQ18	9	#fake sensors involved (globally)
		IQ19	Figure 6	IoTcategory
		IQ20	N/A	average response lag time
		IQ21	N/A	average visit duration
		IQn		…
	Human Observation	O1	"happy"	facial expression while touching the fake sensors
		O2	4	#questions asking for clarification
		O3	N/A	spontaneous posting of an idea in response of a problem statement
		On		…
	Paper Log	PL1	0	#comments on the paper diary
	Question	Q1	variable	perception of the rewarding feature

Figure 12*: Collected data as Reference Indicators for the Green Services co-creation.*

5.3.4 *User Experience Analysis using the KSB model*

As per D4.2.1, ICT Usage Lab researchers performed a data analysis based on the reference indicators listed in table and included, when relevant element of observation/video analysis and/or new indicators when required or relevant.

In the following section, each KSB element is qualified against a scale of low/medium/high on the basis of the collected data.

Such an exercise is a first step towards the elicitation of a rule linking the indicators and the KSB element.

Caveat, in the context of the co-creation workshops, the KSB model is applied hereafter :

For the K elements: the IoT based green services ideas generated via the GenIoT method. Ideas of services created via the Aloha! method are sometimes mentioned for comparative purposes only.

For the S elements: to the online GenIoT experience itself.

For the B elements: to the top 4 services merging both GenIoT and Aloha! ideas

	Ref	Properties	*Input*	*Involved Indicators*	*Value*
Knowledge	K2.2	Sensing affordances	Ideastream database and log	IQ1	low
	K2.4	Conation (Desire)	Observation	O1	high
	K5.1	Self-examination	paper log, Ideastream database and Log	LP1, O1, IQ1	high
	K6.1	Team cognitive process	Ideastream database and log	IQ2, IQ3	low
	K7.2	Shared meanings	Ideastream database and log	O2, IQ4, IQ5	low
	K7.4	Group consciousness	Ideastream database and log	IQ6	low
Social	S1.1	Social Networking	Ideastream database and log	IQ20, IQ7, IQ8	low
	S2.1	Communication	Ideastream database and log	IQ9, IQ10, IQ11, IQ12	low
	S3.2	Influential behaviour	Ideastream database and log	IQ13, IQ14	low
	S4.3	Rewarding	Debriefing	Q1	medium
	S7.1	Attractiveness	Ideastream database and log, observation	IQ21, IQ7, IQ8, IQ15, IQ16, IQ17	medium

	Ref	Properties	*Input*	*Involved Indicators*	*Value*
	S11.1	Caring	observation	O3	low
Business & Societal	B1.1	New functionalities	observation	defined a posteriori for the top voted idea	See Figure 23
	B1.3	level of automation	observation	defined a posteriori for the top voted idea	
	B1.4	scenario complexity	ideastream database and log	IQ18	
	B1.5	ambient intelligence	observation	defined a posteriori for the top voted idea	
	B4.1	usefulness	observation	defined a posteriori for the top voted idea	
	B4.2	potential emotional connection	observation	defined a posteriori for the top voted idea	
	B7.1	potential privacy issue	observation	defined a posteriori for the top voted idea	

Figure 13*: KSB Experience Properties with Indicators for the Green Services co-creation (from D4.2.1).*

5.3.4.1 Interpreting the K elements

K2.2: Sensing affordances: Low [corrected value: medium] In the case of the GenIoT exercise, the objective is to ask participants to identify potential sensing contexts, areas, objects and by extension affordances – in the specific case of green services for mobility. The total number of pictures produced on average by a participant could be an indicator involved in the qualification of such a KSB element. However, as we lack of referential data (GenIoT is not yet a standard procedure), interpretation of the K2.2 cannot be done with an acceptable confidence level. Nevertheless the qualitative analysis of the GenIoT debriefing lets us think that the number of cases documented is below the real sensing affordances. As a consequence, the K2.2 interpreted value is low, yet the corrected value is medium (on a scale of low/medium/high).

More indicators could be used for K2.2 evaluation; indeed the number of both sensors and actuators involved in the IoT green services generated during the co creation sessions could be used to approximate the experiential learning related to new affordances discovery during the co-creation process. Manual analysis of the production during GenIoT allowed identifying for each picture or idea, the number and type of sensors (type of sensed data). In a further version of ELLIOT implementing image recognition algorithms enabling to identify the fake sensors and their colour, part of this analysis could be automated.

IoT systems described in GenIoT contains in average 1.79 sensors (standard deviation 1.15). Aloha! IoT green services involved on average 2.14 sensors (standard deviation 1.41). As there is no referential data available, it is difficult to interpret such values. However, GenIoT values being lower than Aloha! ones, it might be thought that GenIoT affordance projection was less than Aloha! which would then mean that affordance was low. Yet, this would disregard the auto-censorship bias identified during the GenIoT debriefing and make it very hazardous to assess affordance only by the number of sensors. Variation in the nature of the data sensed may also be relevant in the assessment of affordance (a hypothesis could be that variety of the sensor "type" and position of the sensor would be positively correlated with IoT affordance perception). This is why the ICT Usage Lab researchers looked at the distribution of the data sensed and the context of sensing.

All fake sensors left to the participants were used and participate in the variety of the services produced. Most frequently used sensors were similar to the ones enacted during Aloha!.

As shown in

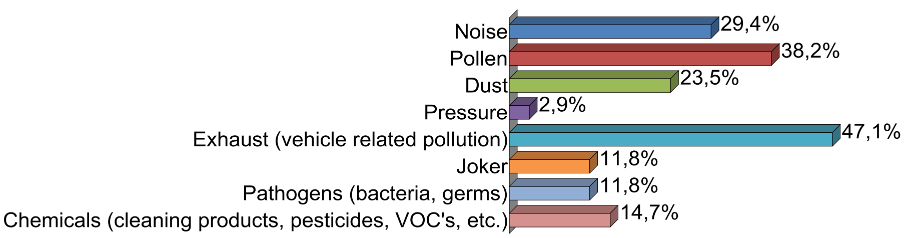
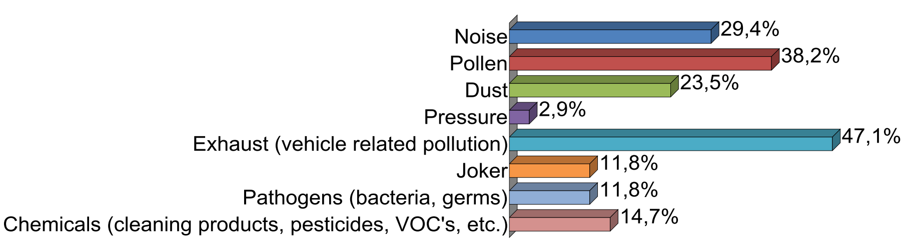


Figure 15 and Figure 16 noise, vehicle and pollen pollution are the concerns inspiring for and raised by the participants but other "threats" such as dust, chemical or bacterial pollution were also considered.



	Nb	% obs.
Noise	10	29,4%

Pollen	13	38,2%
Dust	8	23,5%
Pressure	1	2,9%
Exhaust (vehicle related pollution)	16	47,1%
Joker	4	11,8%
Pathogens (bacteria, germs)	4	11,8%
Chemicals (cleaning products, pesticides, VOC's, etc.)	5	14,7%

Figure 14: Type of the data sensed (called sensor type for short) from GenIoT

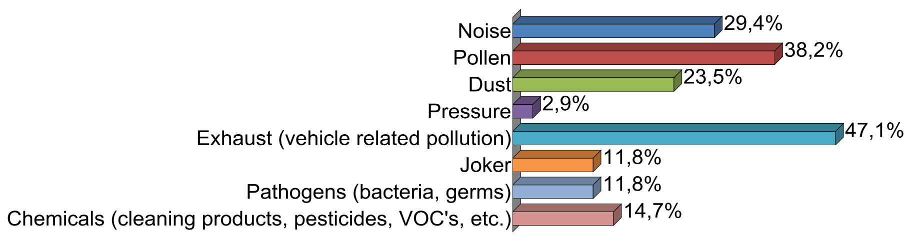


Figure 15: Distribution of the sensors across the IoT green services generated via the GenIoT method

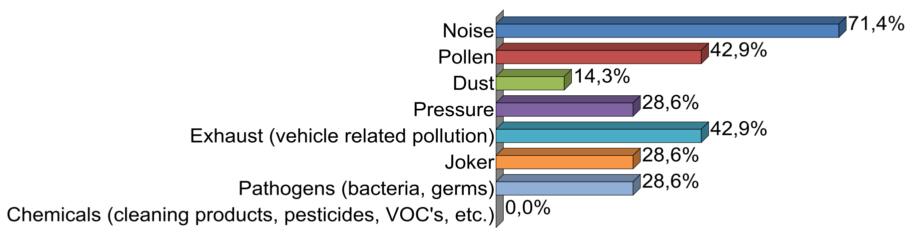


Figure 16 : Distribution of the sensors across the IoT green services generated via the Aloha! method

Further analysis was made related to the positioning of the sensor in terms of indoor/outdoor or hybrid IoT system (CF. Figure 8 E,I and EI), fixed/mobile sensors, and against a classification built from the data itself (as per grounded theory [Glaser and Strauss, 1967][6]) presented in Figure 17.

Tier 1	*Tier 2*	*Tier 3*
Mobile	*Transportation means*	*Tramway*
		Bicycle
		Cars

[6] Glaser BG, Strauss A. Discovery of Grounded Theory. Strategies for Qualitative Research. Sociology Press, 1967

Tier 1	*Tier 2*	*Tier 3*
	Wearable	*Clothes*
	Merchandise - Goods	*Food*
Fixed	*Home-Place of residence*	*Infrastructure*
		Decoration (candle)
	Public space	*Parking*
		Street
		Park
		Tree/Forest
		Beach
	Work space	

Figure 17: Bottom up (data driven) classification/coding scheme of the sensor positioning

Such a coding of the data enables several analyses informing on the potential new affordances for places and objects. Although participants were asked to think about their mobility patterns and air quality, the contexts and potential needs for IoT green services were much wider, witnessing a high commitment in following the method and identifying new affordances.

Moreover, the method used for discovering new IoT related affordances seems to impact on the type and position of augmented object. Indeed, green services generated via GenIoT tend to involve more fixed sensors than Aloha! services as shown in Figure 18.

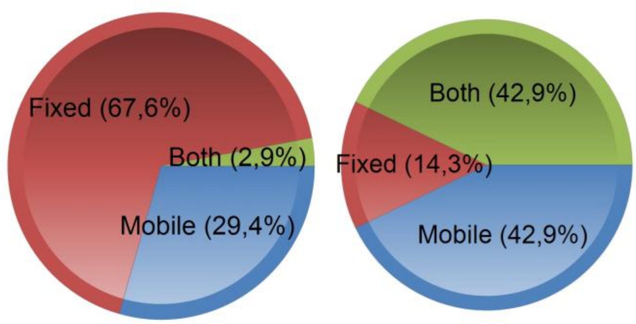


Figure 18: Green Services reliance on mobile/fixed only or both sensors (IoT services generated by GenIoT (left) and Aloha! (right))

GenIoT services also differ from Aloha! as they relate to home automation or at least are ubiquited in the participant place of residence, while Aloha! services take place in the public space and supported by ioT systems placed on public infrastructures, as depicted in Figure 19.

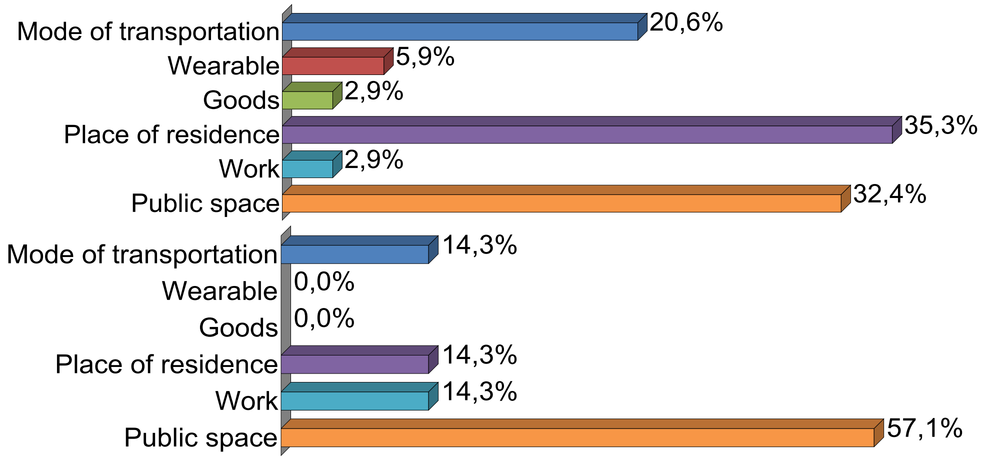


Figure 19: Position of the sensors supporting the green services (IoT services generated by GenIoT (above) and Aloha! (below))

Moreover, the value sensed in the various places is also well distributed as shown in Figure 20. This may also indicate a medium level of affordance.

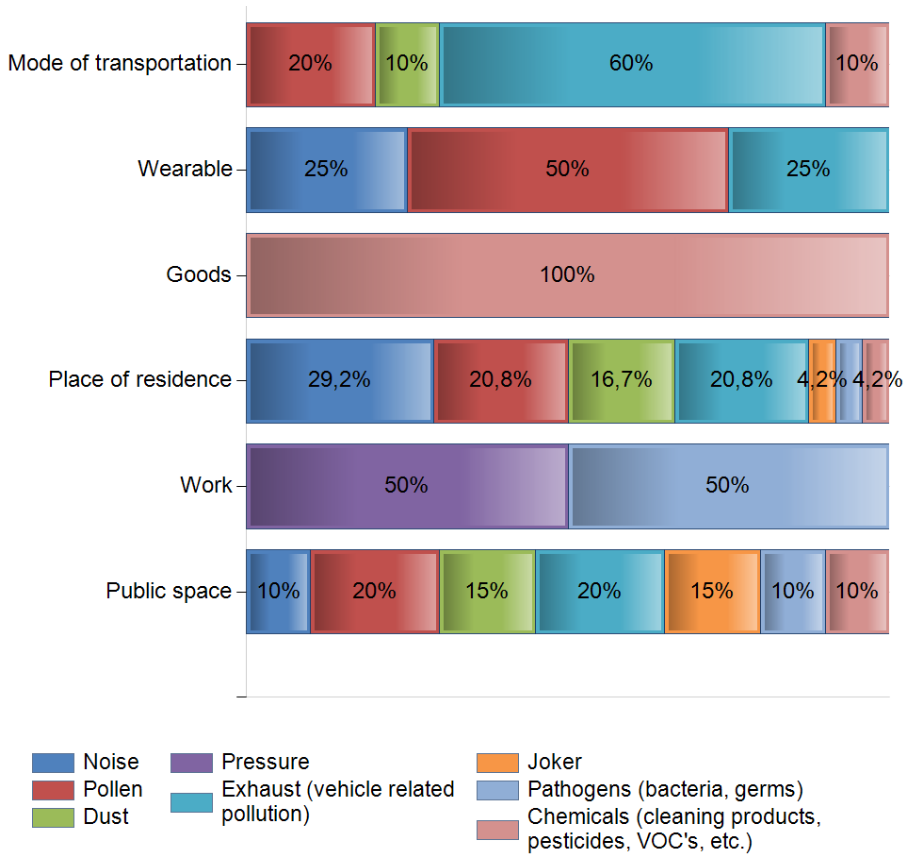


Figure 20: Type and position of the fake sensors for green services generated by GenIoT

GenIoT and Aloha!, by definition of the methods ("sensor push" effect), emphasis the exploration of new sensing affordances. However, these methods leave it very open to define the type of action performed in response to the measurement. During the Aloha! services enactment, actuators were systematically developed; in the case of GenIoT, many pictures or ideas focused on the identification and visualisation of air pollution but did not define a proper action (Figure 21). More specifically, services involving sensors placed on public spaces or infrastructures were considered as a service in itself and participants tend not to specify even the way the measurement could be visualised, shared, interpreted or generate other actions (Figure 22). Conversely, services localised in the home, tend to be coupled with actuators. As the data set is very low, these remarks could appear as subject to caution. However, the video and transcript analysis clearly highlight a difference in forecasting affordances for new IoT services depending on the context of the services. Participants reported that they felt more in control in their house and were therefore willing to be supported in improving the air quality in their private space as well as learn about their own pollution. In contrast, they tend to perceive the public space as an area not in their control and/or responsibility and many of the participants positioned themselves as unarmed and not willing to fight against a global phenomenon, sometimes seen as ineluctable.

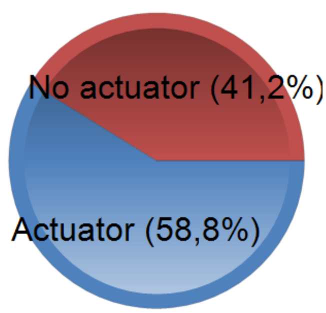


Figure 21: Presence of a specific actuator in the ideas generated via GenIoT

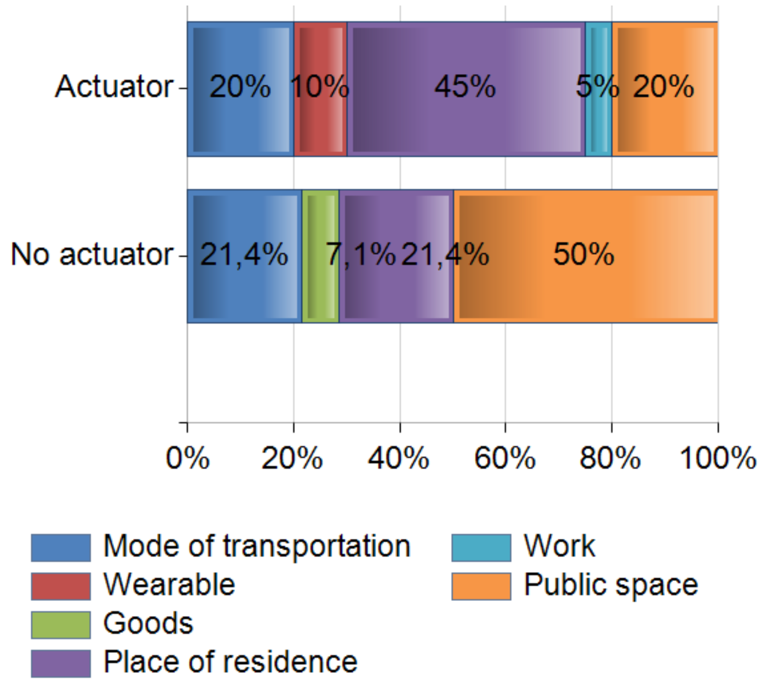


Figure 22: Context of the green services involving (yes) or not (no) actuators

The data set produced by the GenIoT method and the overall distribution of the actuators, would therefore reinforce the idea of a low level of affordance for what regards the objects seen as actuators.

K2.4 Conation: high. Please note that this data refers to the embodied cognition facilitated by the feeling of seeing, touching and placing the magnetic fake sensors. Most of the participants did touch and play with the props sensors during the GenIoT introduction and reported that they started to think about where and when they were going to place them. Most of them appeared amused and interested. Some of them also reported that these "fun" and pleasant haptic sensations encouraged them to focus on their assignment. At the same time these fun and pleasant sensations combined with the positioning of coloured items, as described previously, helped them in the generation of ideas. However, two participants did not experience them or use them during the whole exercise (they claimed that they did not need any artefact to produce an idea). As a conclusion the conation related to the handling of the fake sensors is interpreted as high (on a scale of low/medium/high).

K5.1 Self-examination: high. Paper diary objective was primarily to gather data related to self-examination. However, as nobody filled it in (PL=0), this data source cannot be used within the current data set. As a consequence, the total number of times where participants thought that the challenge could not be traced accurately and the hypothesis against which the total number of ideas (IQ1 + PL1) is directly and positively correlated to the level self-examination, cannot be posed. O1 cannot either be used as a reliable indicator of self-examination as O1 only relates to the starting point of the introspection process. However, spontaneous feedback from several of the participants mentioned the help of the fake props as a reminder and catalyst of the self-examination process. Numerous participants also mentioned they were experiencing a growing awareness in the area of air quality/noise and to a lesser extent the internet of things. Qualitatively a high value can be given to the KSB element for what regards the impact of the GenIoT method in the development of both air/ noise pollution and, to a lesser extent to internet of things.

K6.1 Team cognitive process: low.

IQ2 is low on a scale of low/medium/high. IQ3 the graph of overall communications shows that no team cognitive process happened online. K6.1 is therefore low on a scale of low/medium/high.

K7.2 Shared meanings: low [corrected to high].

Tags usage depended on the participant persona (tags were mainly used by ICT professional/ engineers) and was globally low. As a consequence very few tags were shared among participants. The number of shared tags (IQ5) cannot therefore inform on the shared meanings within this set of data.

However, the face to face debriefing (in order to stick to the WP1 definition of shared meaning as the transformation from tacit to explicit knowledge with focus on this period of the workshop and not the more open idea co-creation) highlighted that several ideas, concepts and priorities were common amongst participants; see for instance the IoT service related to the window automation, or the priority on home pollution or the most often used sensors and their applications. As a consequence face to face explicitation of shared meanings is high (O2 = 4 i.e. low but is only indirectly correlated to shared meanings).

K7.4 Group consciousness: low - As there was virtually no online group interaction, group consciousness is low, as per definition of WP1 for group consciousness.

As GenIoT primary objective is to run an individual introspection this results is not surprising for the online part of GenIoT.

5.3.4.2 Interpreting the S elements

S1.1 Social Networking: low - Due to the very weak on line group activity, indicators identified in D4.2.1 are either not applicable (IQ20) or very low (IQ7 and IQ8). As a consequence, the rule for qualifying online social networking cannot be further elicited or tested. However, the interpreted value of [on line] social networking is clearly low.

S1.2 Communication: low - No online communication occurred between participants: only one comment was posted which remained unanswered. The graph of communication is therefore not applicable in this case and no conclusion can be drawn at this stage on the rule validity.

S3.2 Influential behaviour: low - Only one idea was voted for, it could therefore appear to be a low value hence a low influential behaviour. However, more variables should be included in the rule determining the value of influential behaviour. For instance one may consider the frequency and distribution of the comments for each participant, the value of the comments. More effort should also be done on measuring the impact of such potentially influencing behaviour. Measurement of the influence could also be linked with the measurement of the confidence and the propagation of confidence within the graph of communications.

S4.3 Rewarding: medium - Transcript analysis shows that one participant spontaneously expressed being stimulated in participating to the exercise because of the gamefication system (Q1 for this participant was therefore high). Others situated themselves as moderately motivated by the points attribution. Some did not notice points were given each time they visited the site or posted information. This is why the rewards aspect for online participation can be assessed as medium.

S7.1 Attractiveness: medium - Indicators involved in the measurement of the attractiveness involve on one hand the attractiveness related to the experience of the online tool, which is related to Average visit duration (IQ21), frequency of visit (IQ7), number of comments (IQ8) and is low, and on the other hand the attractiveness of the GenIoT method which required the use of the online tool, which is higher since IQ15, IQ16 and IQ17 (number of ideas globally and per user, comments) are higher. Global attractiveness of the whole online GenIoT process can therefore be qualified as medium.

S11.1Caring: low - As there was neither group consciousness, nor a social network or communication, interest in the caring aspect can be interpreted as low. A number of comments could also be considered in the rule qualifying as caring.

5.3.4.3 Interpreting the B elements

As the IoT based green services co-created during the workshop are at the ideation level, many of the B elements cannot be assessed.

In the following we focus on the elements related to innovativeness (B1) and provide an overall value for each of the top four services.

Performance (B2) and friendliness (B3) were also cited by the participants as requirements for the service, highlighting their importance. However this could not be assessed at this point of the creative process.

Privacy (B7) was recurrently part of the discussions and appears as the main threat for IoT systems diffusion, together with potential impact on health, and social accessibility of the technology which was also reported regularly by different participants.

Please note that the KSB model in its latest version does not mention the potential impact of technology on health and environment as part of the user experience as the societal part was removed. ICT Usage Lab researchers recommendation to insert these elements kept on recurring in the discussions.

As per D4.12, Figure 23 provides an overview of the value for the B1 and B7 elements as well as B4.1. Such values are derived from the transcript analysis of the last workshop. Moreover, an overall value was provided for the whole group.

B4.2 could not be assessed as the concept was not sufficiently developed and is intentionally missing from Figure 23.

When asked about external air monitoring and mobility, participants converged in the identification of 4 types of green services, all 4 services being also potentially included in an urban monitoring initiative:

- Service ID1 involves an IoT system that would allow the display of both the global air pollution (related to transportation means, Co2, NOx, etc. but also pollen) and the individual contribution to such pollution. This system would be placed on the car and able to communicate both with fixed sensors and other embedded sensors. The need is to be able to quantify the action of each individual on the overall pollution as well as to identify most polluted areas.
- Service ID2 involves an IoT system that would enable the optimising of parking in cities

in order to decrease the pollution related to the seeking of parking spaces. Such a system would require sensors to identify free parking slots and would be able to communicate the information to the nearest smartphone searching for a place to park and to "block it" for some minutes. Such a service would rise however several legal issues as use of public space.

- Service ID3 involves a green GPS allowing the calculation and guidance through "green itineraries" and displaying alternative transportation means in order to reduce air pollution.
- Service ID4 involves an IoT system able to optimise the individual car pollution during waiting lines such as at traffic light or jams.

B elements[7]	New functionalities	Automation capacity	Connectivity	Ambient intelligence	Usefulness	Potential privacy issue
Ref [7]	B1.1	B1.2	B1.4	B1.5	B4.1	B7
Definition of the criteria as per WP1	*The degree of creativity expressed by newly designed product or service artefact based on the use of IOT*	*The automation capacity based on the use of IOT The capability to perform activities without, or with minimum conscious human intervention*	*The degree of connectivity provided by the use of IOT.*	*The capacity of ambient intelligence provided by use of IoT. This is an extension of increase in automation capability, and refers to the IoT service/app ability to recognise the user and their situational context reacting in an appropriate manner to this "ambient"*	*In economics, utility is a measure of relative satisfaction. It refers to the total satisfaction received by a consumer from goods or service. Utility is often modelled to be affected by consumption of various goods and services, possession of wealth and spending of leisure time.*	*the individual person right to determine which personal information, is to be shared with whom and for what purpose*
ID1	Medium Instant consumption indication is correlated with car pollution and already exist on cars, however the innovation comes from the fact that personal pollution can be situated among the overall pollution count	Medium Data automation: pollution data are shared among drivers	Medium Drivers are mentally connected to each other	Low	Medium All participants (except one) *declare* such a service would have an impact on their driving habits and decrease pollution but such declarative statements cannot be taken as valid indicators, thus corrected "medium" value".	High As values would be geo-localised the concern for data privacy and anonymity extends to the selective use permission, hence all 3 B7.1 to B7.3 are viewed as high issues.
ID2	High Parking slots are booked and blocked but other system functionalities already exist in Parker app Parker developed by Cooper. *NB: participants did not know app*	Medium However, the idea was downgraded: the initial concept was that a car could be moved automatically in order to optimize the parking.	Medium Drivers are connected to the free parking slots which are indicated thanks to sensors placed on the street.	Medium Drivers need to tell system they are searching for a parking place. They are then geo-localised, a slot is booked for them and they are directed to it.	High for drivers who have a smart phone Low for the others	High As values would be geo-localised the concern for data privacy and anonymity extends to the selective use permission, hence all 3 B7.1 to B7.3 are viewed as high issues.
ID3	Low This service does not exist as such, but similar services providing information on traffic are already in use. Main innovation would come from the merging of pollen and more generic air quality at street level. *NB: the low value is the one perceived by the participants (mainly not experts in air quality)*	Medium Data automation only	Low Please note that connectivity refers here to user perceived connectivity of the IoT service. In the case of this service the technical service involves a high number of sensors interconnected, however the user should not experience it.	Low Service is activated on demand and does not enact any actuator a part from visual / audio .	Medium	Medium Users of the system would be geo-localised for the sake of the GPS like functionality but would not provide any data on air quality or noise, therefore they would only ask for privacy and anonymity.
ID 4	Low IBM and BMW has already implemented parts of the service	High Automatic turn of the engine depending on waiting time and pollution threshold	Low	High Automatic detection of the context (highway, traffic light, high pollution, pollen alert)	Low Usefulness at the individual level was considered as low.	Low Even if geolocalised, the "use with permission" fear was not mentioned as in the other services. This may be correlated to the fact that connectivity was perceived as low.

Figure 23: assessment of the B elements for the 4 top IoT based green services related to mobility

[7] As per D4.2.1

5.4 Preliminary conclusions and data inference coming from performed analysis

In this section the perceived benefits, strengths, weaknesses, opportunities and threats of IoT based Green Services are summarised and more generally the usage of IoT for green services, as expressed by the participants during the workshops (considering both exploration and co-creations sessions).

5.4.1 *Attractiveness of Green Services IOT-based solutions*

IoT is seen by the participants as an efficient way to make air pollution tangible. Communication of the measurement (i.e. green service where is actuator only relates to the visualisation of the measure) is seen as a relevant information, provided it is interpreted or interpretable. Artists did see attractive opportunities in the visualisation of air pollution in the public space, thanks to IoT.

Green services allowing the citizen to take action, feel in command of the air quality, i.e. services targeting internal air are much more attractive than the ones related to the measurement of street pollution therefore global and industrial air pollution.

Typically a service allowing to optimise the internal air quality by opening the windows at the most appropriate time is the most frequent need highlighted by the participants (when asked to co-create short term services and focusing on current daily lifestyle).

Services related to noise monitoring are seen as being interesting mainly for legal reasons, their attractiveness for other purposes is considered low as noise can also be inferred from other information (such as traffic).

IoT as a mean to produce distributed information stemming from the citizen was only moderately seen as attractive; participants were first willing to produce information for themselves, and would share it and benefit from other measures, only under privacy conditions and only as a second level objective.

When asked to choose[8] one service among the top 4 mentioned above, participants discarded ID4 green service but could not really elect one amongst the 3 remaining as scores for ID1 to 3 were very close (yet ID3 was chosen for the experimentation phase of this project as it involves both the green watches and the electric vehicles as per the DOW). Moreover, participants left

[8] Choice was performed by using a point attribution system and considering vote criteria co-created by the participants such as personnel interest, maturity of the service concept, technical feasibility, economic viability and innovation.

the co-creation workshops with a slight disappointment of not having generated a disruptive and/or attractive IoT based green service.

Despite the high attractiveness of IoT as a potential catalyser for green services, and playful and creative methods, the actual services co-created were not found that attractive.

However, services are still at the stage of the concept; their attractiveness could therefore increase while designing their supporting tools and artefact.

5.4.2 *Acceptance of Green Services IOT-based solutions*

When asked the open question of the criteria for a viable service in the specific case of the IoT green services for mobility, participants answered spontaneously the following criteria (by order of elicitation of the criteria):

- Economic profitability
- Protection of private data
- Impact on health
- User friendliness
- Get enough users in order to get reliant measures and data
- Degree of innovation
- Possibility of experimenting the service

Business model for such services are seen as addressing first another objective than air pollution management or people change of behaviour; indeed the participants expressed that economic profitability of green services would come only if such services also highlight another business goals such as the attractiveness of a region, time gained in using the service

Many actors would be involved in the running of such a services, citizen call for local territories (urbanist), rental cars providers, car equipment providers, public transportation and infrastructures for building complex business models in order to share the cost and benefits of such green services. This would increase the acceptance and usage of the green service by the citizen.

Protection of privacy and health appear as main obstacles for IoT based green services, as participants ask for a guarantee and would prefer not to use the service if they do not have such guarantees.

User friendliness and the integration of the service within existing routines are seen as a major factor for service success. IoT potential intrusiveness was not seen as a main hurdle however, participants did express their wish to remain in control of the situation, where/whenever.

As any service involving social interaction, the IoT based green service requires a critical mass of users in order to demonstrate its value- the more users, the more values there are and more precise are the maps; participants pointed out this chicken and egg problem as a potential threat to service usage.

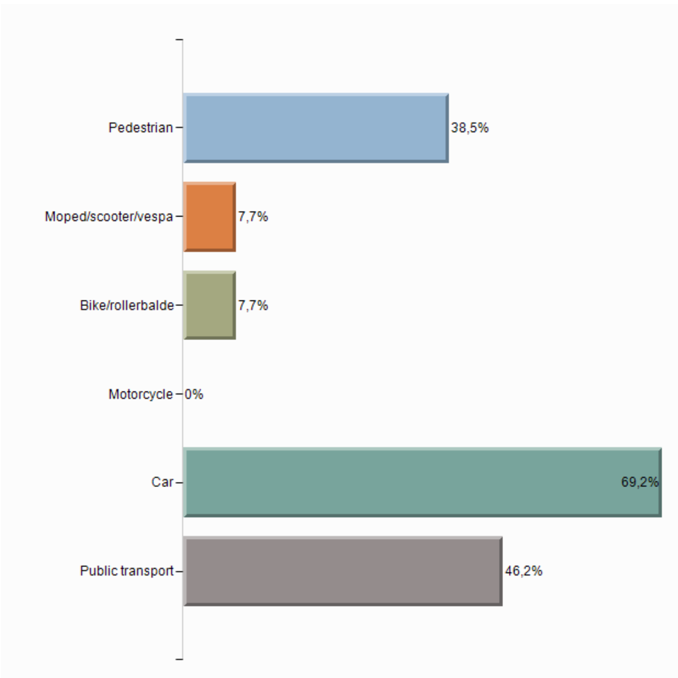
The participants were, during the last co-creation workshop asked to come up with a few services to be tested in the near future. This pressure for a short term vision of the service influenced them in choosing services they tend to consider less innovative (in terms of new functionalities, not from the technological viewpoint) in order to be able to quickly run the experiment.

6 Conclusions [UR]

The work conducted so far has shown the need for a more thorough and detailed definition of some of the indicators to be used for the KSB mapping. In particular it has proven difficult to deal with the social and knowledge aspects when it comes to extrapolating data from sensors and especially when no ground truth data is available in respect to the user state of mind and emotions during the usage of the IoT service. It is expected that this activity will be carried out in an interactive workshop that will be carried out shortly after the delivery of the present document.

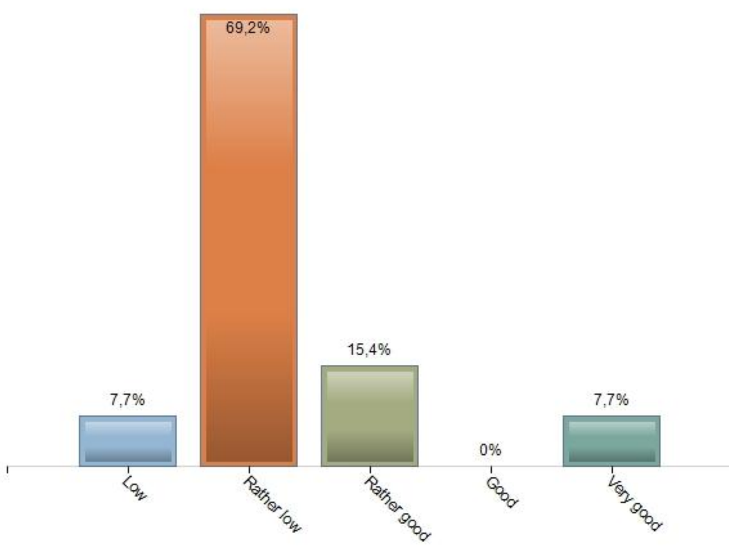
7 Appendix 1 for Green Services Use Case

7.1 People data: Answers to the Mobility/ Air/Health questions



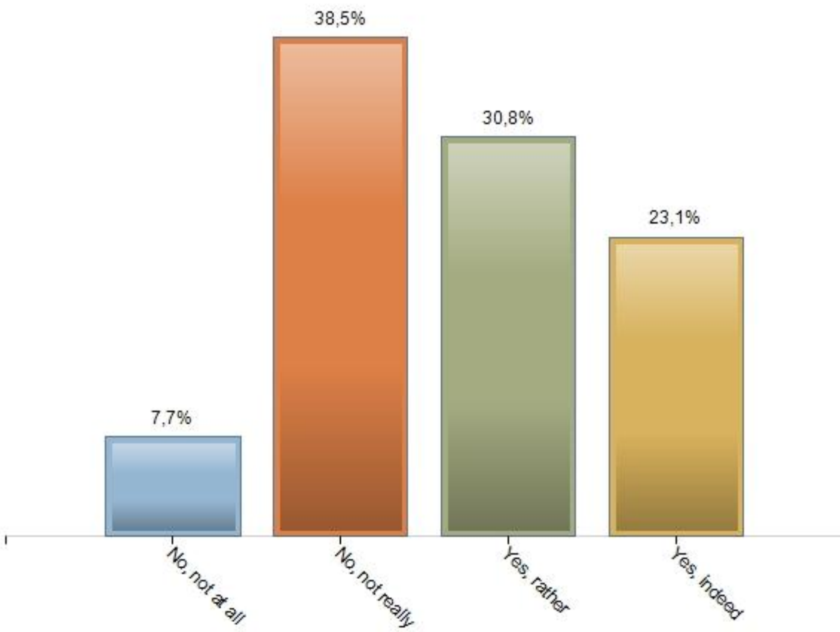
	Nb	%obs.
Pedestrian	**5**	**38,5%**
Moped/scooter/vespa	**1**	**7,7%**
Bike/rollerblade	**1**	**7,7%**
Motorcycle	**0**	**0,0%**
Car	**9**	**69,2%**
Public transport	**6**	**46,2%**
Total	**13**	

Figure 24: Answer to "What is your main mode of transportation?"



	Nb	% cit.
Low	**1**	**7,7%**
Rather low	**9**	**69,2%**
Rather good	**2**	**15,4%**
Good	**0**	**0,0%**
Very good	**1**	**7,7%**
Total	**13**	**100,0%**

Figure 25: Answers to "What is your level of knowledge in the field of air quality?"



	Nb	% cit.
No, not at all	**1**	**7,7%**
No, not really	**5**	**38,5%**
Yes, rather	**4**	**30,8%**
Yes, indeed	**3**	**23,1%**
Total	**13**	**100,0%**

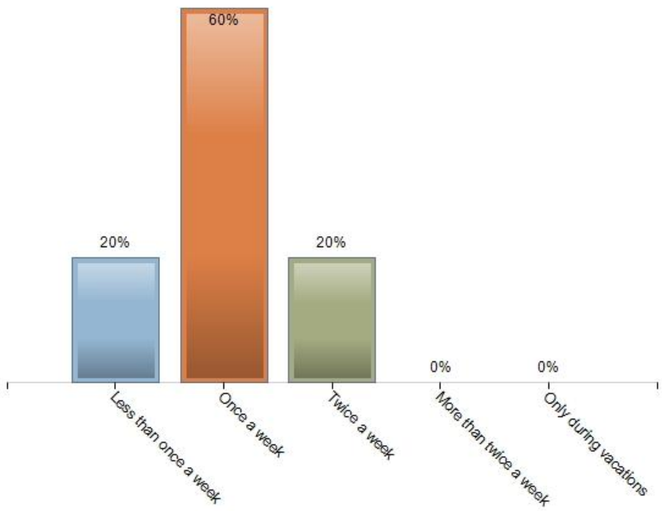
Figure 26: Answers to what extent do you feel concerned by cardio respiratory problems (personal case or your friends)?

	Nb	% cit.
Yes	**8**	**61,5%**
No	**5**	**38,5%**
Total	**13**	**100,0%**

Figure 27: Answers to "Do you belong to an association or sports club?"

	Nb	% cit.
Yes	**5**	**38,5%**
No	**8**	**61,5%**
Total	**13**	**100,0%**

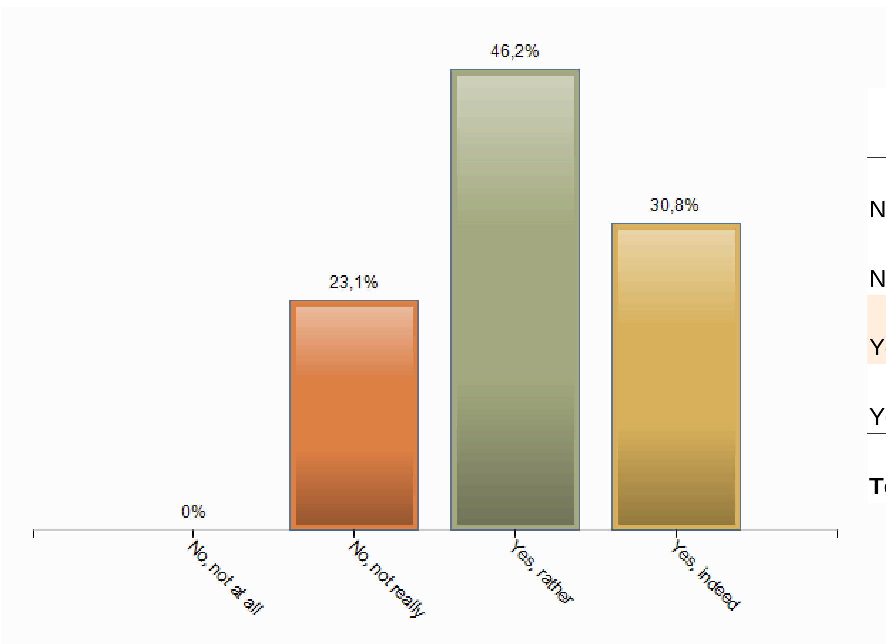
Figure 28: Answers to "Do you regularly practice a sport outside?"



	Nb	% cit.
Less than once a week	**1**	**20,0%**
Once a week	**3**	**60,0%**
Twice a week	**1**	**20,0%**
More than twice a week	**0**	**0,0%**
Only during vacations	**0**	**0,0%**
Total	**5**	**100,0%**

Figure 29: Answers to "What is the frequency of your practice?"

7.2 People data: Answers to the « Participants and Sustainable Development » question



	Nb	% cit.
No, not at all	**0**	**0,0%**
No, not really	**3**	**23,1%**
Yes, rather	**6**	**46,2%**
Yes, indeed	**4**	**30,8%**
Total	**13**	**100,0%**

Figure 30: Answers to "To what extent do you consider that you work for Sustainable Development?"

	No, not at all	No, not really	Yes, rather	Yes, indeed	**Total**
I am involved in projects in my neighbourhood	**16,7%**	**33,3%**	**33,3%**	**16,7%**	**100,0%**
I buy organic food or fair (incl. AMAP)	**0,0%**	**15,4%**	**46,2%**	**38,5%**	**100,0%**
I am active in a charitable, environmental and citizen	**15,4%**	**23,1%**	**38,5%**	**23,1%**	**100,0%**
I am careful not to pollute	**0,0%**	**7,7%**	**76,9%**	**15,4%**	**100,0%**
I prefer cycling, public transport and car pooling	**7,7%**	**23,1%**	**53,8%**	**15,4%**	**100,0%**
I sort and recycle my household waste	**0,0%**	**7,7%**	**23,1%**	**69,2%**	**100,0%**
I have put in place energy saving measures	**7,7%**	**30,8%**	**38,5%**	**23,1%**	**100,0%**
Total	**6,7%**	**20,0%**	**44,4%**	**28,9%**	

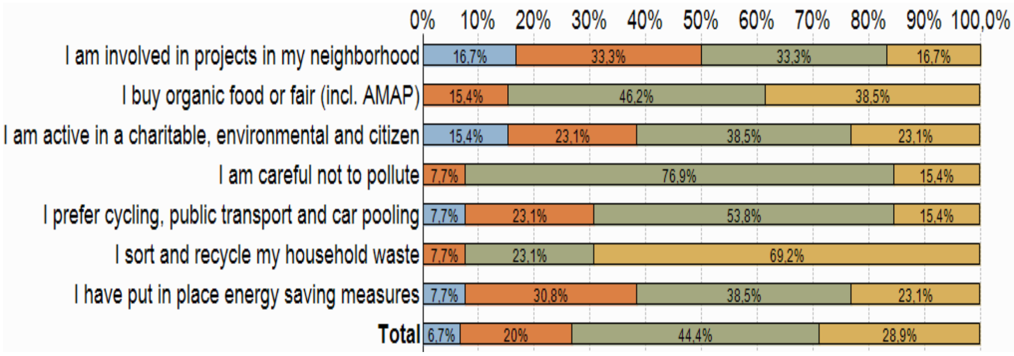


Figure 31: Answers to "Indicate your agreement to the following statements :"

7.3 People data: Answers to the « Your relation to ICT » questions

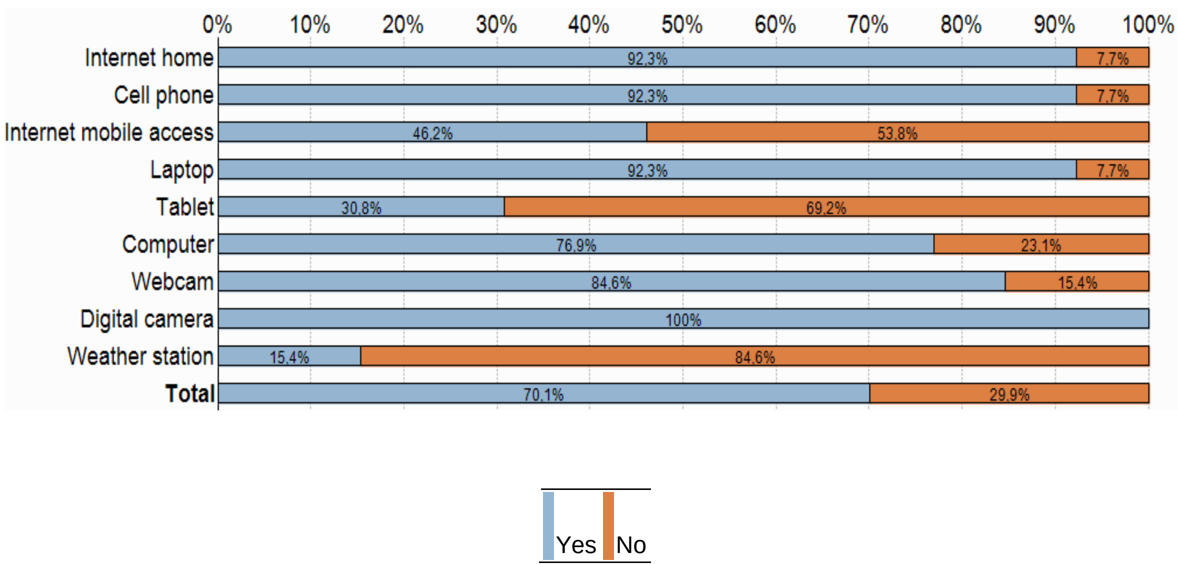


Figure 32: ICT equipment: Answers to "Do you have this equipment:"

Yes	**6**	**46,2%**
No	**7**	**53,8%**
Total	**13**	**100,0%**

Figure 33: answers to Do you connect to the internet via mobile devices?

	No, not at all	No, not really	Yes, rather	Yes, indeed	**Total**
Are you concerned about (e) questions of security of personal data online?	**7,7%**	**7,7%**	**23,1%**	**61,5%**	**100,0%**
Would you say that "ICT improve the quality of life"?	**0,0%**	**7,7%**	**61,5%**	**30,8%**	**100,0%**
Would you say that "ICT are intrusive, invasive"?	**15,4%**	**23,1%**	**46,2%**	**15,4%**	**100,0%**
Are you in favour of opening public data (consultation and use by all citizens and businesses)?	**8,3%**	**8,3%**	**41,7%**	**41,7%**	**100,0%**

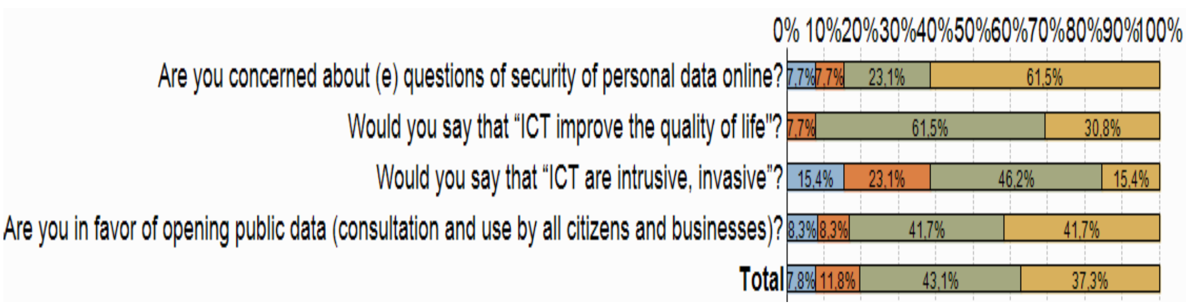
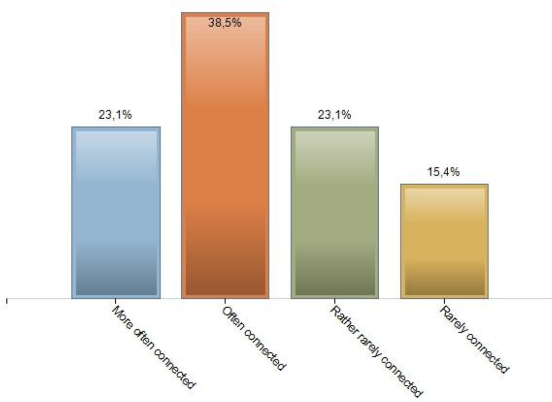


Figure 34: Relationship to ICT



	Nb	% cit.
More often connected	**3**	**23,1%**
Often connected	**5**	**38,5%**
Rather rarely connected	**3**	**23,1%**
Rarely connected	**2**	**15,4%**
Total	**13**	**100,0%**

Figure 35: Answers to the question: If you had to estimate your mobile phone use, would you say you are?

	Nb	% cit.
Yes	6	46,2%
No	6	46,2%
I don't know	1	7,7%
Total	13	100,0%

Figure 36: Have you ever used contactless payment?

	Nb	% cit.
Personal	**0**	**0,0%**
Professional	**0**	**0,0%**
Both	**13**	**100,0%**
Total	**13**	**100,0%**

Figure 37: What is your use of ICT ?

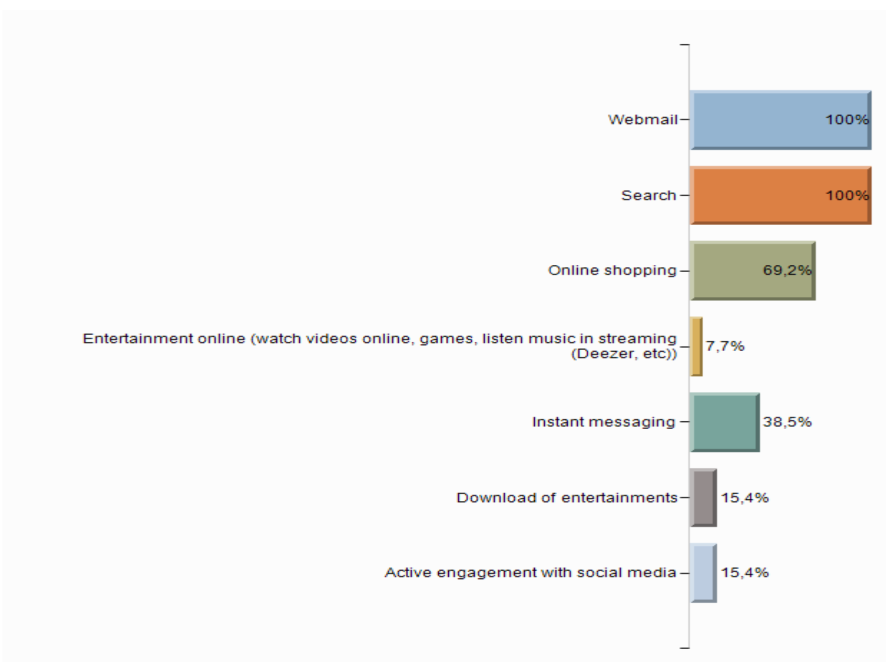


Figure 38: Answers to "On the internet, what are your main activities?"

7.4 People data: Answers to the demographics questions

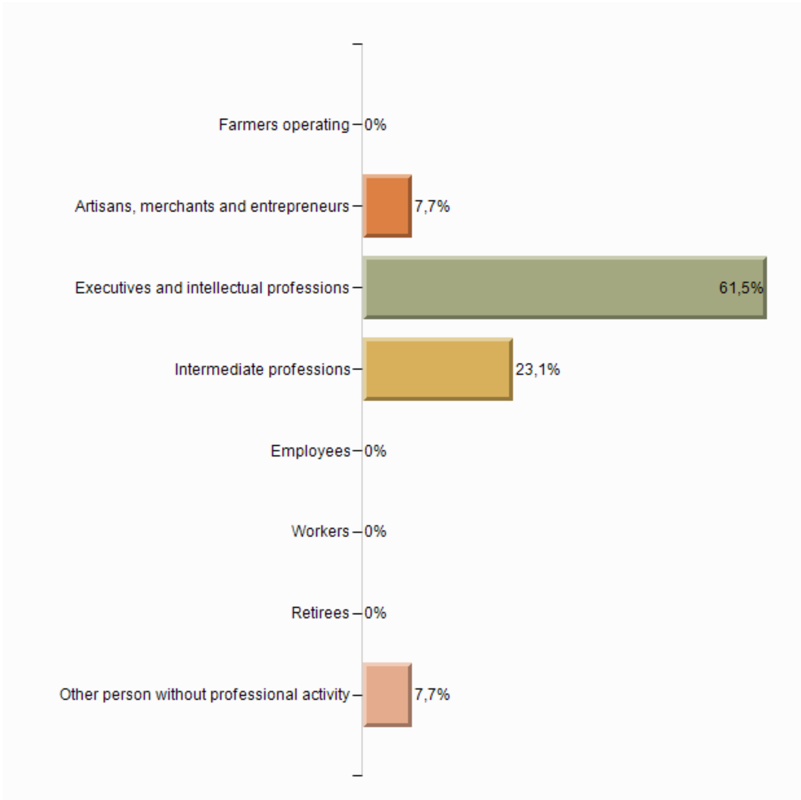


Figure 39 Occupational group of the participants

	Nb	% cit.
18-25 years	1	7,7%
26-35 years	3	23,1%
36-45 years	6	46,2%
46-55 years	3	23,1%
More than 55 years	0	0,0%
Total	**13**	**100,0%**

Figure 40: Age of the participants

	Nb	% cit.
Yes	6	46,2%
Non	7	53,8%
Total	13	100,0%

Figure 41: Answer to “do you have at least one child (minor)?”

	Nb
Saint-Laurent	1
Nice	9
Coaraze	1
Grasse	1
Opio	1

Figure 42: Location of residence of the participants

	Nb
Sophia-Antipolis	3
Nice	8
Grasse	1
Monaco	1

Figure 43: Location of professional activity of the participants

	Nb	% cit.
INRIA (SA)	**5**	**38,5%**
Le Hublot (N)	**8**	**61,5%**
Total	**13**	**100,0%**

Figure 44: Distribution of the participants (SA: Sophia Antipolis and N: Nice groups)

7.5 Co-creation workshop: List of user visits on Ideastream

IDUser	IDVisit	Start	End	TotalSize (octets)	#Clicks	#BadClicks
1	1	05/12/2011 10:32	05/12/2011 11:07	667034	58	1
1	2	06/12/2011 08:51	06/12/2011 08:52	94001	5	1
2	3	28/11/2011 16:58	28/11/2011 16:58	9670	1	1
2	4	05/12/2011 14:44	05/12/2011 14:44	9771	1	1
2	5	08/12/2011 08:28	08/12/2011 08:38	517768	24	1
2	6	08/12/2011 09:09	08/12/2011 09:13	403717	20	2
2	7	06/12/2011 14:04	06/12/2011 14:24	1907313	47	0
2	8	08/12/2011 08:39	08/12/2011 08:40	66844	5	1
2	9	05/12/2011 11:35	05/12/2011 11:35	10012	2	1
2	10	05/12/2011 14:00	05/12/2011 14:11	29750	4	3
2	11	05/12/2011 14:48	05/12/2011 15:00	631988	22	0
2	12	05/12/2011 15:30	05/12/2011 15:45	52149	2	0
3	13	14/12/2011 14:51	14/12/2011 14:52	19724	3	2
3	14	14/12/2011 15:48	14/12/2011 15:48	9771	1	1
3	15	13/12/2011 23:29	13/12/2011 23:41	3454733	22	1
3	16	15/12/2011 14:01	15/12/2011 14:03	127850	6	0
4	17	02/12/2011 22:20	02/12/2011 22:20	9771	1	1
4	18	04/12/2011 22:12	04/12/2011 22:16	285611	11	1
4	19	06/12/2011 23:20	06/12/2011 23:50	338531	15	0
4	20	08/12/2011 21:38	08/12/2011 22:06	4531303	33	0
4	21	09/12/2011 09:17	09/12/2011 09:17	20809	1	0
3	22	05/12/2011 20:11	05/12/2011 20:11	9771	1	1
3	23	06/12/2011 08:56	06/12/2011 09:53	591661	27	1
3	24	06/12/2011 10:46	06/12/2011 11:37	895384	48	2
5	25	11/12/2011 13:19	11/12/2011 13:44	743478	42	0

5	26	11/12/2011 14:37	11/12/2011 14:37	90633	6	2
5	27	12/12/2011 20:02	12/12/2011 20:03	230484	10	1
5	28	17/12/2011 21:48	17/12/2011 21:50	126245	6	0
6	29	02/12/2011 15:26	02/12/2011 15:27	84243	7	2
3	30	20/12/2011 18:40	20/12/2011 18:42	113937	11	1
3	31	21/12/2011 18:26	21/12/2011 18:28	140423	8	1
7	32	02/12/2011 09:45	02/12/2011 10:13	392017	22	1
7	33	02/12/2011 14:37	02/12/2011 14:39	94520	5	0
7	34	09/12/2011 12:26	09/12/2011 12:38	1517889	18	1
7	35	12/12/2011 15:29	12/12/2011 15:30	92815	6	1
7	36	12/12/2011 12:32	12/12/2011 12:33	91774	6	2
7	37	12/12/2011 13:39	12/12/2011 13:39	71978	2	0
8	38	06/12/2011 14:41	06/12/2011 15:29	1762321	34	14
8	39	06/12/2011 17:07	06/12/2011 17:21	602158	50	0
2	40	11/12/2011 22:01	11/12/2011 22:04	2438762	21	1
1	41	01/12/2011 16:48	01/12/2011 16:50	142441	10	1
1	42	02/12/2011 16:25	02/12/2011 16:32	269101	14	0

Figure 45: List of User visits

7.6 Co-creation workshop: Idea words/User Graph

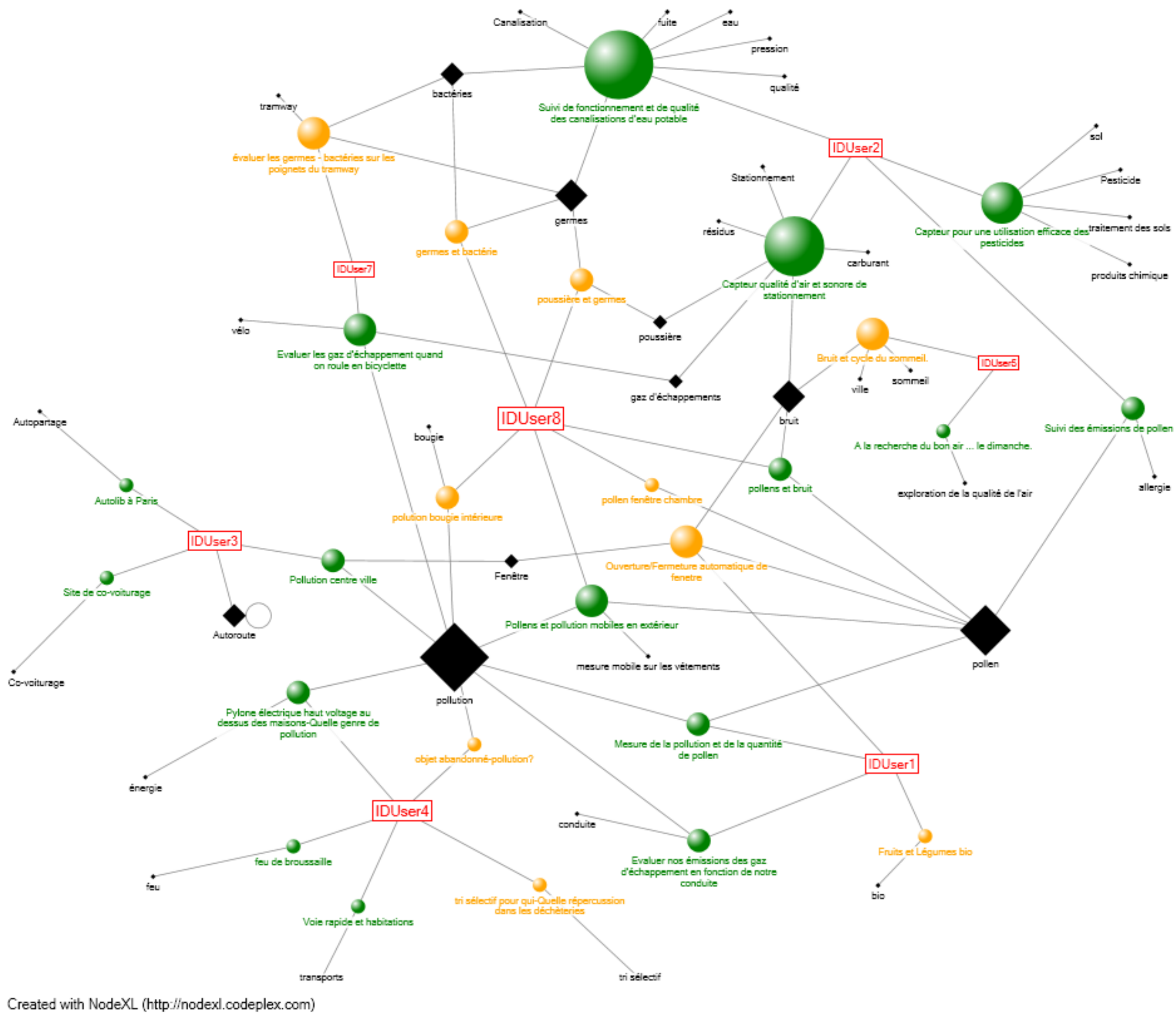


Figure 46: Complete Graph

Green=idea(E); Yellow=idea(I); Black square=common words from tags and titles; red=IDuser; black= words from tags and titles

In the above graph and in black boxes, we see common words used in the idea titles and shared tags.